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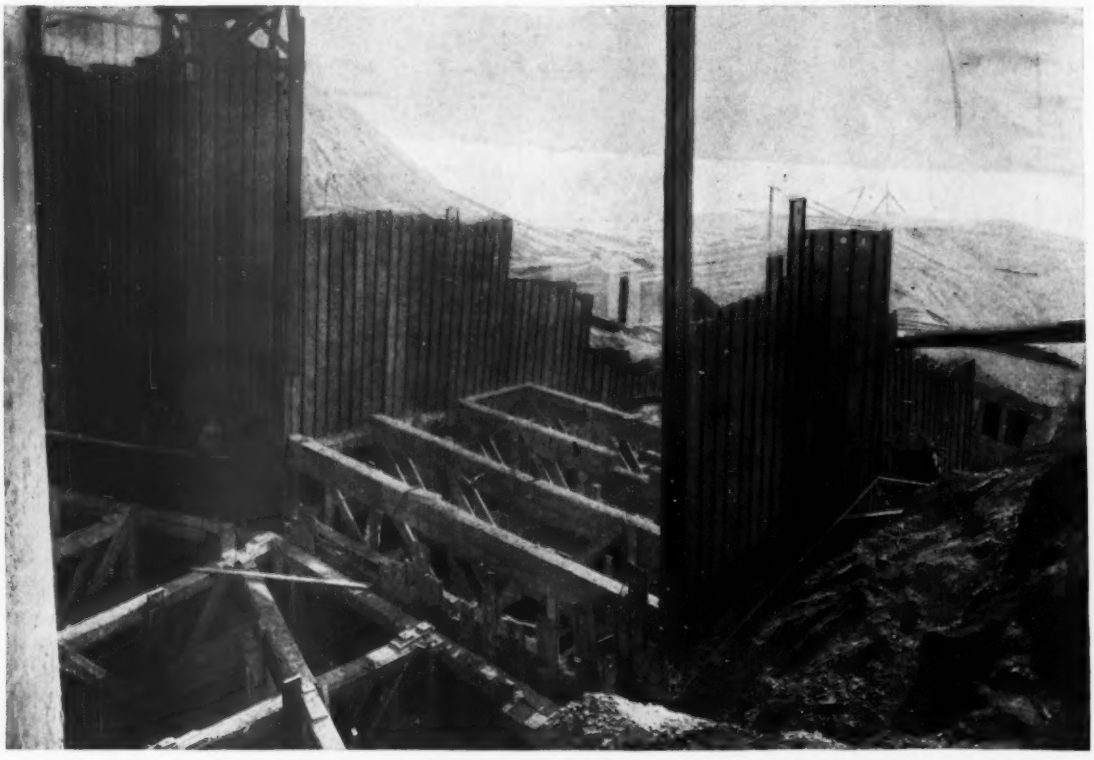

Lackawanna Steel Sheet Piling Was Sorely Tried Here, but as Usual, Made Good

The open cofferdams of Lackawanna Steel Sheet Piling for building intake and discharge tunnels at the new plant of the Union Gas & Electric Co., on the Ohio River bank at Cincinnati, Ohio, were driven under unusually severe conditions, the location being an old dump from a rolling mill and a gas plant. In many places the soil contained cinders, cast iron, wrought iron, wooden foundation piles, bolts, sunken logs, and naphthalene, and below this conglomeration there was spongy gravel and fine sand. The penetration required of the sheet piling varied in different places up to 65 feet, spliced piling sections being used in the deeper locations.

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Engineering News

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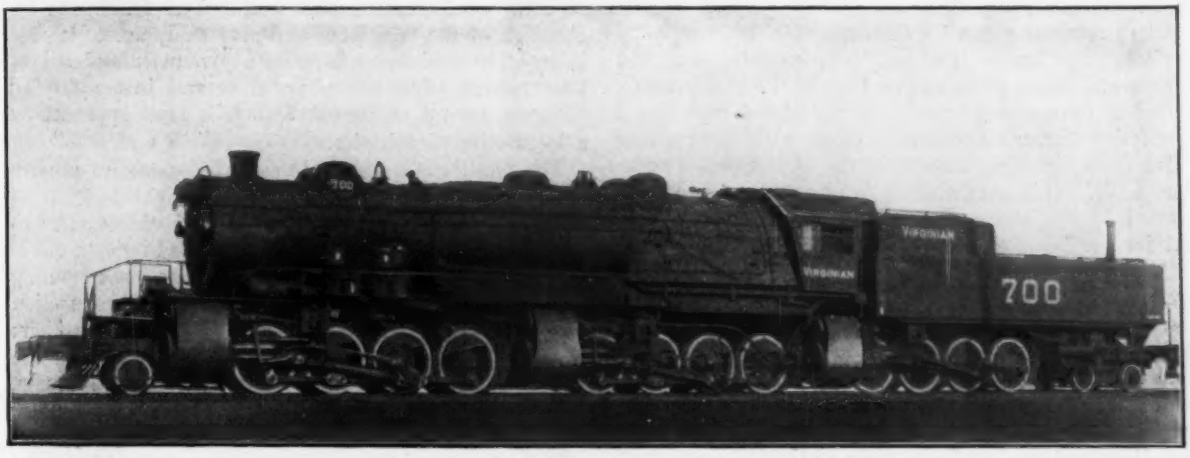
Virginian Railway Has World's Greatest Steam Locomotive

A new record in size and capacity of railway locomotives has been made by the triple articulated 422-ton freight locomotive patented by George Henderson and built by the Baldwin Locomotive Works for the Virginian Ry. As shown in the accompanying illustrations, it has a 2-8-8-8-4 wheel arrangement, and in its general features is similar to the slightly smaller triple locomotive built for the Erie R.R. (as described in *Engineering News*, May 7, 1914). The maximum tractive effort of the Virginian unit is 166,300 lb. It has a height limit of 16 ft. 10 in. and a width limit of 12 ft. at a height of 2 ft. 3 in. above the rail. The center line of the boiler is 10 ft. 9 in. above the rail. The rigid wheel base is 15 ft. 3 in. and the total wheel base 91 ft. 3 in. The Erie locomotives, it will be recalled, had a total weight of 422.5 tons, a rigid wheel base of 16 ft. 6 in., and a total wheel base of 90 ft. The maximum tractive effort was 160,000 lb.



THE LARGEST STEAM LOCOMOTIVE IN THE WORLD
Triple compound locomotive built by the Baldwin Locomotive Works for the Virginian Ry.

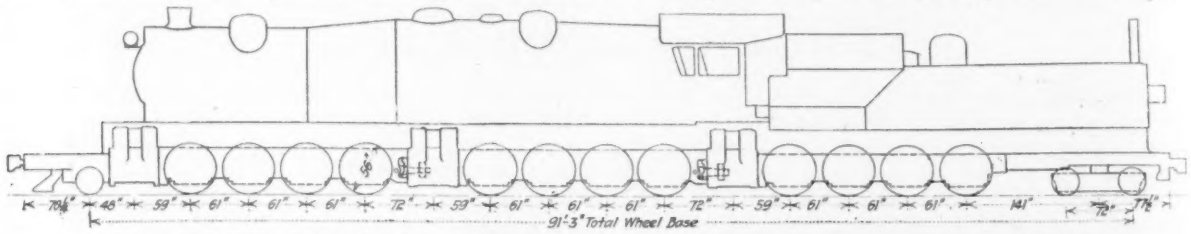
The Virginian locomotive, like its prototype, has a third set of cylinders and driving wheels under the locomotive tender, all cylinders of the same size with the two center cylinders taking high-pressure steam and discharging to the end pair of cylinders working on lower pressure, a huge superheater, a feed-water heater on the tender, etc.

Flanged tires are used throughout, the lateral play between flanges and rails being $\frac{1}{4}$ in. on the front and back drivers of each group, and $\frac{3}{8}$ in. for the main and intermediate pairs. Since the railroad has no turntable capable of taking this unit, it is turned on Ys, laid out with a curvature of 18°. The three groups of driving wheels carry approximately an equal load (60,500 lb. per axle). The weight of the overhang on the tender is carried by a four-wheeled constant-resistance engine truck. This has a total swing of 13¼ in. and carries a load equal to that of an express passenger locomotive of 30 years ago—82,000 lb.

The frames are vanadium-steel castings 6 in. wide. The radius bars at the two articulated connections are attached to horizontal transverse pins, fitted with case hardened, spherical bushings to provide flexibility in both vertical and horizontal planes and to prevent binding of the hinge pins when passing over sudden changes in grade or poorly surfaced tracks. The structural details show several unusual steel castings. For instance, the weight bearers supporting the forward part of the boiler and the three guide bearers are all bolted to both upper and lower frame rails and form effective transverse frame braces. The front bumper beam and deck plate are combined in a large steel casting, which houses the draft gear.

The boiler is of the wagon-top type and has a maximum diameter (third ring) of 110 in. Longitudinal seams are all placed on the top center line. The dome ring seam is welded for its entire length, and the seams on the first and second rings are welded at the ends. The circumferential seams between the second and third rings, and between the third ring and the throat and outside firebox sheets, are triple riveted. The back tube sheet is straight and the tubes are 25 ft. long. The furnace (Gaines type for soft coal) has its arch supported on five tubes. The firebox is above the middle group of driving wheels and the available space for the throat is restricted.

Throat depth has been increased by depressing the front bar of the mud ring between wheels. Flexible stay bolts are used for the throat and back of the firebox, and in the breakage zones of the sides. Four rows of expansion stays support the forward end of the crown. The mud ring is supported on vertical plates front and back, and at one intermediate point where the load is transferred to the plate through a transverse cast-steel brace, which supports the longitudinal grate bearers. The ash pan, in spite of limited space, has two large hoppers with cast-steel bottoms and drop doors. A longitudinal duct runs through the pan to carry the back receiver pipe and reach rod. Air is admitted at the front of each hopper and near the top of the duct at each side, as well as under the mud ring.



SKELETON ELEVATION OF TRIPLE COMPOUND LOCOMOTIVE, SHOWING WHEEL SPACING

The superheater has 65 elements with 2059 sq.ft. of surface. The header is of cast iron in one piece. The superheater steam pipes leading back to the high-pressure cylinders have slip joints. The right-hand pipe has a connection through a cast-steel elbow with the starting valve (Simplex type) located in the high-pressure cylinder saddle. This saddle is in two pieces, the upper being riveted to the boiler shell. The lower piece is cored out for the intercepting valve and pipe connections.

All six cylinders were cast in the same pattern and are of vanadium iron, designed so that ¾-in. bushings can be subsequently used if desired. The pistons have dished heads of forged steel with cast-iron bull rings, held in place by electrically welded retaining rings. The piston rods are of nickel-chromium steel and are without extensions. The cross-head bodies (Laird type) are of vanadium cast steel and are made as light as consistent with demands for strength. The main crank pins are of nickel-chromium steel, and are hollow bored. The main and side rods and main driving axles are of chrome-vanadium, heat-treated steel. Vanadium steel is used for the driving tires and springs.

The valve motions are of the Baker type controlled by a Ragonnet power-reverse mechanism. When working compound the high-pressure cylinders exhaust into a common chamber, which communicates with the front and back receiver pipe. During starting, an interceptor valve admits live steam to front and back receiver pipes, as well as to the high-pressure cylinders, and the high-pressure exhaust is conveyed to the smoke box through a separate pipe which terminates in an annular nozzle surrounding the main nozzle. The intercepting valve is arranged so that steam can be admitted through a pipe connection from the cab and the locomotive worked on single expansion at any time. When drifting, saturated steam can be admitted to the high-pressure cylinders through a special pipe connected with a valve in the cab.

The exhaust steam from the rear cylinders passes through a feed-water heater placed under the tank on the tender. This heater consists of a long drum 22 in. in diameter, traversed by 31 tubes of 2¼-in. diameter and provides 437 sq.ft. of heating surface. The exhaust steam passing through the feed-water heater is released through a small stack at the rear of the tender. The exhaust from the forward cylinders is led to the main nozzle in the smoke box and used for creating draft.

The feed water is handled by a piston pump working between the tank and heater, and placed under the tank and back of the rear drivers. This requires a flexible connection in the steam line leading to the pump, but the arrangement is justified by the greater reliability of the pump working on cold water. The locomotive has two injectors for emergency use.

The cab is roomy and permits convenient arrangement of fittings. The front wall is sloped to follow the inclination of the back head and give ready access to stay bolts. The equipment includes a pyrometer and a low-water alarm. The use of power reverse in simplifying the arrangement of the cab fittings is most apparent on a locomotive of this size.

The sanding arrangements on this locomotive are interesting. Four sand-boxes are placed right and left of the boiler, two for the forward group of wheels and two for the middle group. The tender tank carries a sand-box for the rear group, with the discharge pipes running through the tank in 4½-in. vertical pipes. In connection with the sanders (Graham-White type) are rail washers at each end of the locomotive. A special valve in the cab controls the sand and washing water simultaneously. When the valve handle is turned in one direction, sand is delivered under the front drivers of each group, and water is discharged through the washing pipes at the rear; if the handle is turned in the opposite direction, sand is delivered under the rear drivers of each group and water is discharged through the front washing pipes.

PRINCIPAL DATA OF 2-8-8-8-4 TRIPLE LOCOMOTIVE, VIRGINIAN RY.

General	
Gage	4 ft. 8½ in.
Cylinders	34x32 in.
Valves (piston)	14 in. diam.
Boiler	
Type	Wagon-top
Diameter	100 in.
Thickness of sheets	⅞ in., 1 1/16 in., 1⅛ in.
Working pressure	215 lb.
Fuel	Soft coal
Staying	Radial
Fire Box	
Length	188 in.
Width	108½ in.
Depth, front	93½ in.
Depth, back	75½ in.
Thickness of sheets, sides	½ in.
Thickness of sheets, back	½ in.
Thickness of sheets, crown	½ in.
Thickness of sheets, tube	½ in.
Grate, length	144 in.
Water Space	
Front	5½ in.
Sides	5 in.
Back	5 in.
Tubes	
Diameter	5½ and 2¼ in.
Thickness	5½ in., No. 9 W. G. 2¼ in. No. 11 W. G.
Number	5½ in., 65; 2¼ in., 365
Length	25 ft.

Heating Surface	
Fire box	359 sq. ft.
Tubes	7689 sq. ft.
Firebrick tubes	72 sq. ft.
Total	8120 sq. ft.
Superheater	2059 sq. ft.
Grate area	108.2 sq. ft.
Driving Wheels	
Diameter, outside	56 in.
Diameter, center	49 in.
Journals	11x13 in.
Truck Wheels	
Diameter, front	30 in.
Journals	6½x14 in.
Diameter, back	30 in.
Journals	6½x14 in.
Wheel Base	
Driving	67 ft. 7 in.
Rigid	15 ft. 3 in.
Total	91 ft. 3 in.
Weight, Estimated	
On driving wheels	726,000 lb.
On axle	60,500 lb.
On truck, front	36,000 lb.
On truck, back	82,000 lb.
Total	844,000 lb.
Tank capacity,	13,000 U. S. gal.
Fuel capacity	12 tons
Tractive force	166,300 lb.

Rail-Chairs and Tie-Plates on the Northern Pacific Ry.

Experiments with large baseplates, or rail-chairs, secured to the ties by through-bolts are being made on a test section of main track on the Northern Pacific Ry. These experiments form part of a series of tests made in conjunction with the Forest Service of the United States Department of Agriculture, which began in 1905-07 with the seasoning and treating of ties of Western species of timber. These ties were afterward put in two test tracks to determine their relative durability with cut-spikes and screw-spikes and with several types of tie-plates.

Coöperative experiments with the rail-chairs having bolt fastenings, in comparison with tie-plates held by cut-spikes, were begun in 1915, the screw-spikes used in the test tracks not having proved very satisfactory. For this purpose a stretch of about 3000 ft. of track near Thompson Falls, Mont., was laid with wood ties of different species, some of which were equipped with the malleable-iron rail-chairs secured by bolts through the ties, while others had the railway company's standard tie-plates and cut-spikes. The length of track included curves and carried heavy traffic. It had 90-lb. 33-ft. rails, 19 ties per rail, with about 12 in. of sandy gravel ballast (of inferior quality) on a well-drained roadbed.

Two types of rail-chairs were tried, one of which (made of malleable iron) is shown in the accompanying drawing. The form used on intermediate ties (shown at the left) is 12¼ x 7 in., with hollow lugs on the bottom which enter sockets cut in the ties. The joint chair is of similar construction, 16½ x 7 in., weighing about 15 lb., but is secured to the tie by two screw-spikes independent of the bolts that secure the rails. Each rail-chair has two bolts. The bolt has a short square shank and button head on the lower end (with a washer between the head and the tie), and its threaded end engages a threaded sleeve having a nut head.

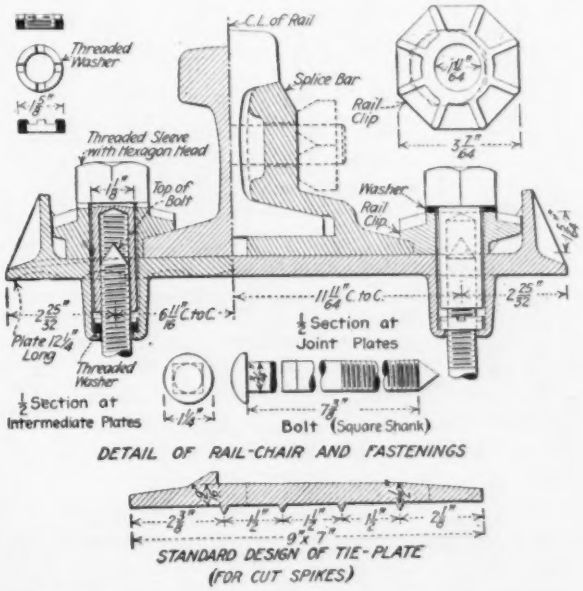
This sleeve passes through an eccentric clamp that grips the rail base. The eccentric construction allows for varying the gage, using rails with different widths of base, and taking up the wear of the rail-head, by shifting the position of the clamp without removing the bolt. Thus such adjustments may be made with less damage to the ties than where spikes have to be drawn and redriven. The rear of the clamp has a bearing against a rib on the chair. A threaded washer in the bottom of the pocket holds the bolt in place until the sleeve is applied or when the sleeve is removed. A claim made for this fastening by the maker is that it will allow for shimming up the track.

The other form of rail-chair (made either of rolled steel or malleable iron) has a flat plate without bottom lugs and is held in place by two screw-spikes independent of the bolts that secure the rails. The joint chair used with this was the same as described above. In both cases the rails were spliced with the continuous joint, as shown, the flanges of which were not slotted. Both forms of rail-chairs were made by the Vignoles Rail-Chair Co., of Chicago (represented by A. G. Liebmann, 7433 Emerald Ave., Chicago).

The standard rolled-steel tie-plates of the Northern Pacific Ry., used on other sections of the test track, are 7 x 9 in., ½ to $\frac{9}{16}$ in. thick under the rail and with sharp ribs on the bottom. This also is shown on the accompanying drawing. The upper surface has the rail seat inclined slightly inward (about $\frac{1}{16}$ in. in 5 in.) and has a shoulder along the outer side. Ordinary $\frac{9}{16}$-in. cut- or drive-spikes are used (two to each rail). The rail joints are spliced with angle bars having the flanges slotted for the spikes, to hold the track from creeping.

An inspection of this track was made after seven months' service, including the severe winter of 1915-16. During this period the ballast had been frozen for a considerable time, and the traffic was exceptionally heavy. It was found that both types of bolted rail-chairs prevented creeping of the rails. Where tie-plates and cut-spikes were used, this creeping occurred, as shown by the skewing of ties at joints (the track being laid with broken joints). There was also a tendency in the latter case for the ties to bunch near the joints after only seven months' service.

No work had been done on the ties equipped with the rail-chairs since they were laid, and the track was still in good condition as to line, surface and gage.



RAIL-CHAIRS WITH THROUGH-BOLT FASTENINGS, AND TIE-PLATES WITH SPIKES; NORTHERN PACIFIC RY.

It was found necessary to tap down all the cut-spikes about the middle of March and again during May, and a few of the joints had to be tamped up, due to the shifting of the ballast.

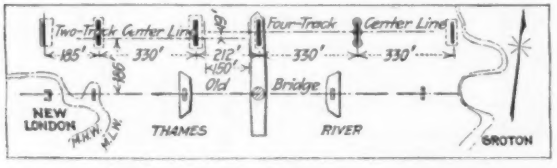
It was noticed that trains make less noise and ride more easily in passing over the track laid with bolted rail-chairs than over that laid with the tie-plates held by common spikes. This is due probably to the fact that with the former the chair, rail and ties are held together more firmly, without any play. At the time of inspection this track had not been in place long enough to show any difference in wear of ties of the various species or between those with rail-chairs and tie-plates.

The track is still in service and will be inspected from time to time. Information as to the track construction and tests has been furnished by P. R. Hicks, Engineer in the United States Forest Products Laboratory (at Madison, Wis.), and L. Yager, Acting Engineer of Maintenance-of-Way, Northern Pacific Railway.

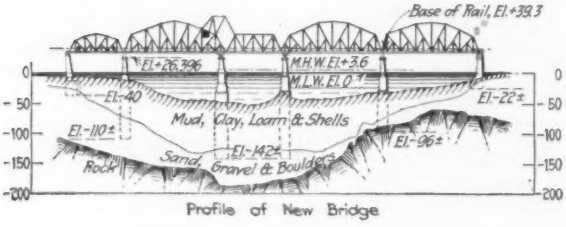
Deep Dredging Piers and Multiple Pneumatic Pier on the Thames Bridge

SYNOPSIS—To found a heavy four-track bridge in over 100 ft. of soft clay or mud, three piers are being sunk to gravel by open dredging, two going 140 ft. below water. Interesting crib framing. Jet pipes are used to help in sinking. The cribs are launched and floated to the site. A multiple-caisson pneumatic foundation to rest on sloping rock will be built for the fourth pier.

Open-well dredging is the method used for constructing the chief part of an unusually difficult and costly bridge foundation—that for the new Thames River bridge of the New York, New Haven & Hartford R.R., at New London, Conn. The two channel piers, supporting a trunnion bascule bridge and adjoining 330-ft. fixed spans,



Plan of New and Old Bridge



Profile of New Bridge

Profile of Old Bridge

FIG. 1. GENERAL LAYOUT OF THAMES RIVER BRIDGE AT NEW LONDON, N. Y., N. H. & H. R.R.

will go down to 140 ft. below mean tide, while the west pier goes down to 96 ft. (see profile, Fig. 1). However, the pneumatic-caisson process will be used for one of the four piers, which is the east pier.

The subsoil is mud or soft clay for 50 to 100 ft. depth, water being 20 to 50 ft. deep, and below the mud is firm gravel to support the deep piers. Rock is found at the east pier at practicable depths, permitting pneumatic work without exceeding air pressures in which men can work. The unusual feature here is that the rock shelves down in the upstream direction rather abruptly; and to avoid sinking the caisson cutting edge into rock or, on the other hand, resting one corner on rock and then undercutting at the opposite edge for quite a depth in sheeted excavation, three separate caissons will be used, 35 ft. c. to c., each 22 ft. in diameter, supporting a single pier shaft (Fig. 3).

Work on the dredging piers is well under way. Construction of the pneumatic pier has not yet begun at the site. Holbrook, Cabot & Rollins, of Boston, are doing the work.

The old bridge, about 200 ft. downstream of the new location, has its piers resting on piles. It was not desired to use piles for the new bridge, however, as the soft river-bottom loam or clay would not give adequate lateral support to a pile cluster in the degree requisite for the bridge. It is important to observe that the new bridge is designed for ultimate four tracks and the substructure will be built for the final width, though only a two-track superstructure will be erected for the present. Four-track design required not only unusually large piers, but also made permanent and undoubted stability a specially important consideration. In fixing on the foundation design many other structures were studied and all available data given due consideration, as it was recognized that the problem called for high engineering skill and judgment to produce a foundation that should be at the same time stable and economical. The design adopted is the plan of the New Haven's engineering department, primarily of Edward Gagel, chief engineer.

The pier supporting the bascule trunnion is 42 x 99 ft. in the lower, or crib, portion and will go down 140 ft. below low water. The sinking is well begun, the caisson cutting edge being at the present time at about 100 ft. below water. The other deep pier, Pier 3, on the east side of the channel, is 30 x 94 ft. in plan and goes down to substantially the same elevation, —140 ft. The west pier, of the same size, 30 x 94, goes down 96 ft. and has already been landed and concreted. Interesting details of construction and special methods of framing and launching were employed in the dredging piers.

Concrete Cutting Edges Under Timber Cribs with Vertical Tie-Bars

The cribs for the three dredging piers are of practically identical design (see Fig. 2). Each has eight rectangular wells about 10 x 12 ft. in the well shaft, flaring out in the lower 13 ft. of height to the full one-eighth of the pier-base area 15 x 23½ ft. for Piers 1 and 3; 20¼ x 24¾ ft. for Pier 2). The cell spaces between the wells therefore taper sharply inward at the bottom to the cutting edge, around the outside of the crib and between the wells. This cutting edge is a monolithic mass of reinforced concrete, to a height of 13 ft.; it is shod with a steel plate that extends 3 ft. up on either side and is anchored by a framework of angles enveloping the cutting-edge concrete.

The crib framing begins at the 13-ft. level. It consists of solid courses of 12 x 12 timbers making up the outer walls and the walls of the dredging wells. As sketched by the corner detail, Fig. 8, the wall timbers and the necessary tying between walls are provided for by an arrangement of three successive courses, one with continuous longitudinals (and in the transverse walls filler pieces), the next with continuous transverse timbers (and in the longitudinal walls filler pieces) and the third composed wholly of filler pieces in the walls in both directions. The courses are driftbolted together. There

are no vertical rib timbers, but instead, at 3-ft. spacing, vertical steel tie-straps about 4x½ in., of which every third one runs up to the top, while the other two stop at lower points of the crib. These straps are spiked to every course. The concrete filling placed in the cell spaces during the sinking is bonded vertically by 1¼-in. twisted reinforcing bars. The outside of the outer walls and the inside of each dredging well are made tight by a sheathing of 3-in. plank with calked joints. Vertical planking was used for the lower 16 ft. and above this horizontal planking, the latter being more convenient to place.

These piers are fitted with a new piece of equipment intended to facilitate sinking through the clay or mud—namely, jetting pipes leading to the cutting edges, embedded in the cutting-edge concrete and led up through the cell spaces to suitable water headers at the top. The discharge nozzles on these pipes point downward and away from the cutting edge in the dredging wells and upward and away from the cutting edge on the outside. The pipes are spaced about 8 ft. apart. Those on the outside face of the outer cutting edge, which point upward, are intended for reducing the skin friction of the pier, if sinking should prove difficult.

The timber work of the crib becomes embedded in the concrete forming the pier body, composed of that which is filled into the cell spaces during sinking and the subsequent filling of the dredging wells when the pier is bottomed. This timbering is built up only to the designed river-bottom height, above which level a plank-wall cofferdam will be placed as protection for the work of concreting the shaft, or upper, portion of the pier.

Crib Built on False Bottom on Shore and Launched

The lower portion of the pier crib is framed on shore on a ship railway, the cutting edge is concreted, and the structure is then launched on a false bottom, floated to its site and sunk, after being built up high enough to project above the water when embedded in the bottom. The pier cribs for Piers 1, 2 and 3 have already been built and launched; the first one has been dredged down to final level, and the pier is practically completed.

The ship railway, located about a mile north of the bridge site, has a sliding platform on its ways. On this platform, blocked up over the keel blocks, was laid a false bottom of 4-in. timber, calked water-tight, on which the crib structure was erected. Longitudinal 12x12 timbers laid on 4-in. nailing strips on the floor furnished bearings for the cutting-edge steel. Reinforcing and forms for the cutting edge were then built up

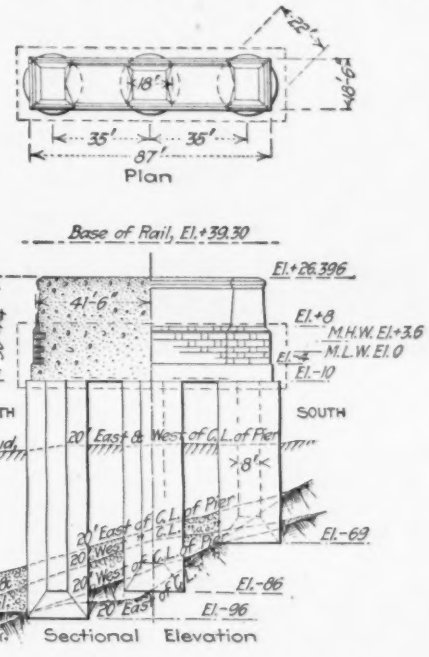


FIG. 3. MULTIPLE-CAISSON PIER (PIER 4) OF NEW THAMES RIVER BRIDGE

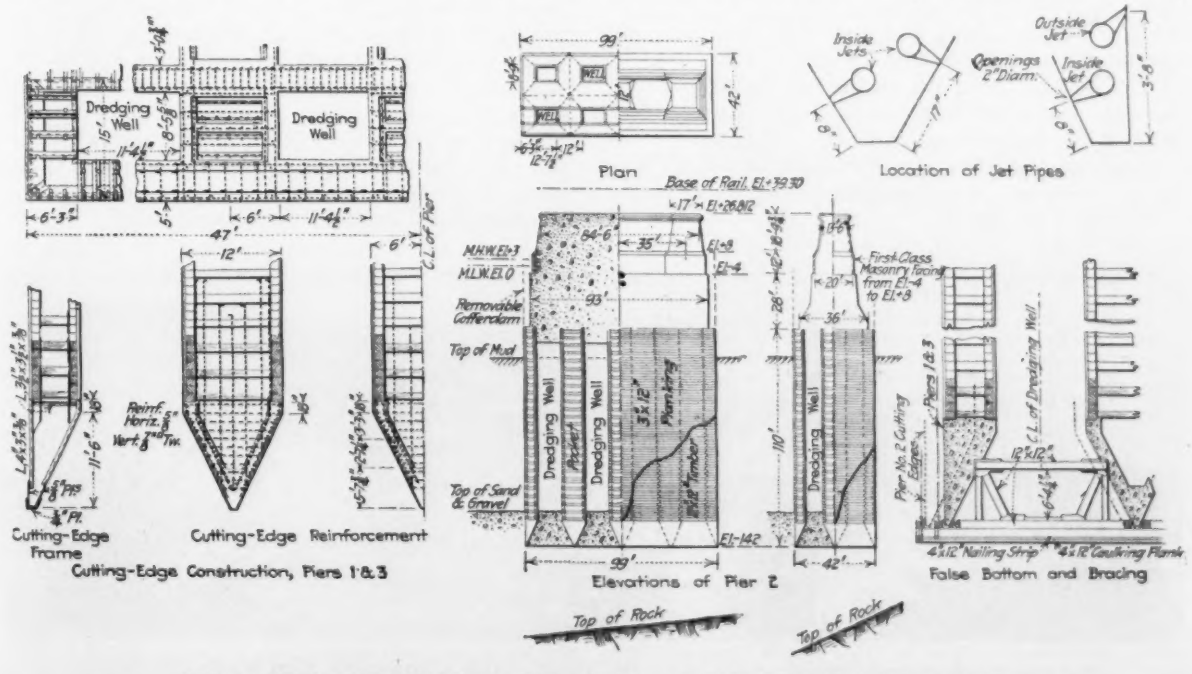
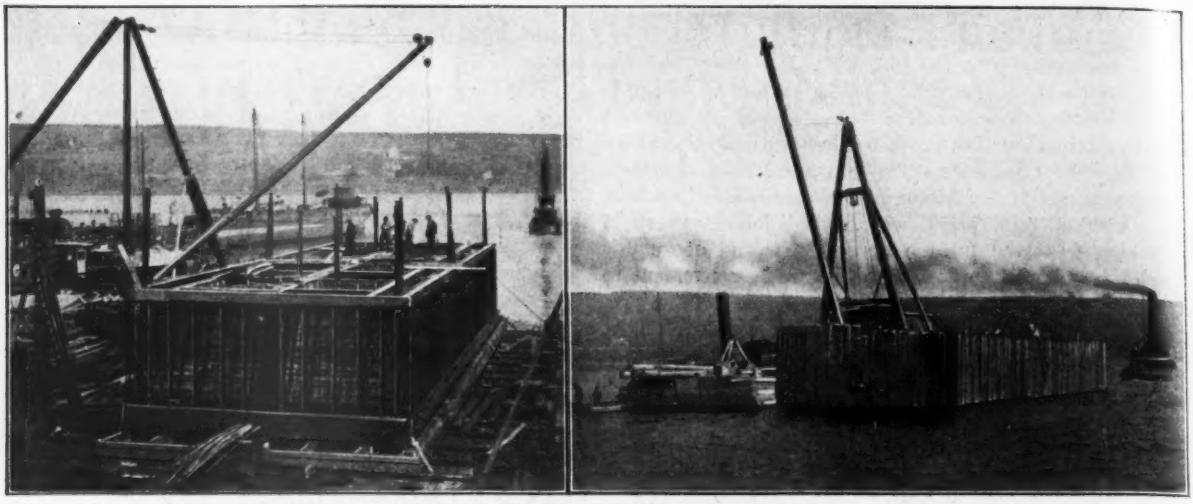


FIG. 2. DEEP OPEN-DREDGING PIER (PIER 2) OF NEW THAMES RIVER BRIDGE



FIGS. 4 AND 5. ONE OF THE THAMES RIVER BRIDGE PIER CRIBS READY FOR CONCRETING THE CUTTING EDGE, AND WHILE FLOATING TO THE SITE

and several courses of the crib timbering set before concrete was poured. The jetting pipes were of course placed at the same time, as were also the straps embedded in the concrete and extending up to tie the timberwork together.

The 13-ft. height of concrete was placed in several successive lifts. A mixing plant on the wharf alongside, served by a stiff-leg derrick, supplied all concrete for this work by way of bottom-gate buckets handled by the derrick.

The launching floor, or false floor, is intended to make early launching possible and must stay in place and remain water-tight until the floating crib has been built up 15 or 20 ft. higher. The water pressure against the floor—nearly 1 ton per sq.ft. at the initial draft—is taken by three trusses of inverted queen-post construction built across the bottom of each well, supporting the 4-in. planking on lines about 4 ft. apart. Tightness between floor and crib is secured by a calking timber around the outer edge as shown in Fig. 2.

The different wells are not isolated from each other, since the cutting edges are about 18 in. above the floor; nevertheless, the structure trims well. Complete stability calculations were made for various conditions of the structure, so that the margin of stability and the trim, etc., were known in advance.

The crib was built up to 22-ft. height for launching. The launching floor reduced the draft at launching to about 17 ft. After building up the crib by an additional 16-ft. section, the floor could be removed, and the draft then was about 35 ft. To place the pier crib on the bottom ready for dredging operations to begin, it was necessary to remove the floor and then gradually load the structure until it rested on the river bottom. The removal of the false bottom is done by filling the dredging wells with water to equalize the pressure on the false bottom, dumping a sufficient quantity of mud or sand into the dredging wells to overcome the flotation of the timber in the false bottom itself, then pumping a slight amount of additional head into the dredging wells, which forces the calking seam between the crib and the false bottom.

In the removal of the false bottom from Pier 1, trouble was experienced at the corners of the dredging wells on account of the heavy pressure, which sprung the corners of the wells, allowing sufficient leakage to sink the crib. The latter was readily raised by floating over it a portion of the final upper caisson, clamping this to the sunken structure by long rods, calking the joint and pumping out. The trouble was then remedied by introducing a system of additional bracing in the lower section, between the outer walls and the dredging-well walls.

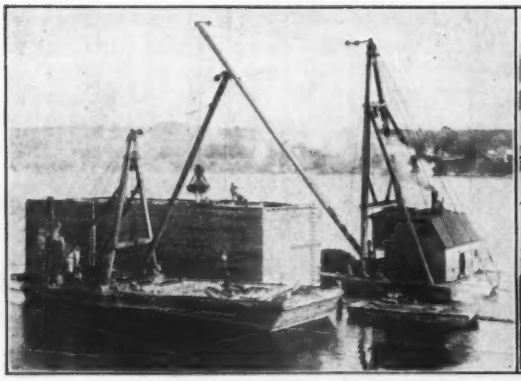


FIG. 6. DREDGING DOWN PIER 1

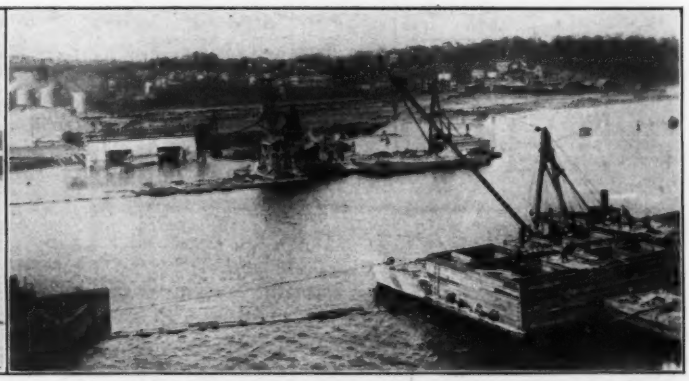


FIG. 7. VIEW FROM PIER 2 TO WEST ABUTMENT; PIER 1 COFFERDAM BETWEEN

Dredging was done by orange-peel, handled by a derrick on a derrick scow alongside the pier. The order and frequency of dredging operations were wholly at the direction of the engineer's inspector on the pier, but every effort was made to carry on the work in such a way as to minimize the number of moves of the derrick scow. Neither the loam or clay (the lower strata of the soft ground appeared as more or less typical clay) nor the gravel below gave any trouble in dredging.

Dredging the Piers Down

The jetting pipes on the inside of the cutting edges were used more or less throughout the work; they are found to have considerable value in loosening the material. The jetting pipes on the outside of the caisson, however, proved to have little effect in loosening the structure from the surrounding mud (lubricating effect), but on the contrary the water seemed to flow back under the cutting edge into the inside, against the full water head.

The dredging was facilitated by an extra jet pipe, handled from a lighter alongside. This consisted of a 4-in. pipe about 106 ft. long, with a 2-in. jetting nozzle on the lower end together with a rosette of four or five

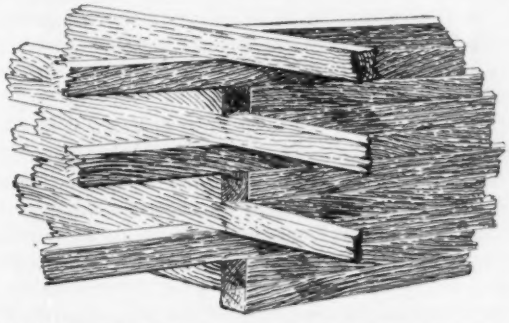


FIG. 8. SKETCH OF PIER-CRIB FRAMING SHOWN AT CORNER OF A WELL

⅜-in. holes, the 2-in. nozzle pointing straight down and the small holes discharging in a horizontal plane. This pipe was connected to the pump by a flexible connection and could be moved at will, from well to well, or shifted about in any well. This proved the most effective method of loosening the material to be excavated from the wells.

No difficulty was found in keeping the piers vertical and in position. Levels were read, and at the same time center-line observations made, twice a day. The dredging was so controlled as to correct any error of level or, when necessary, produce a slant in one direction or another to force the pier over into line if it was found to be off line slightly.

Some boulders have been found in the upper portion of the gravel stratum and the sand directly above it. They give a certain amount of trouble at times by tendency to collect, the buckets dredging out mainly the smaller stuff until more or less of a layer or pocket of larger stone has formed, which interferes with digging.

The crib for Pier 1 was set Sept. 6, 1916, in the mud of the river bottom, with the cutting edge at El. — 43, and was bottomed at El. — 96 on Nov. 23, a period of 78 days being taken for the building up and sinking. This includes sinking the caisson 53 ft., placing approximately 280 M b.m. of timber (exclusive of the temporary cofferdam sides), and placing about 3000 cu.yd. of concrete in the cells. Very little sinking took place except as a result of dredging; the actual dredging was in operation about seventy-four 10-hour shifts. The addition of concrete or timber produced practically no sinking. The average sinking per shift of dredging was 0.6 ft.

After the pier was bottomed, the dredging wells were sealed with concrete deposited by a tremie of 15-in. pipe, the tremie at the beginning of the operation being 106 ft. long. Each well was sealed to a depth of 60 to 80 ft. After all wells had been sealed, the temporary cofferdam and remaining portion of the well section were pumped out and the pier shaft completed.

A facing course of granite masonry is carried around the pier from El. — 4 to El. + 8, covering the tidal range. The joints in this masonry are not pointed with cement mortar; the pointing is done by calking the joint for a depth of about 1 in. with lead wool.

At the present time Pier 2 is in progress of sinking. The permanent timber has all been placed and two-thirds of the concrete in cells has been placed. The progress per 10-hour shift of dredging, to date, has been at the rate of 1.5 ft. The cutting edge is now below El. — 100. The crib of Pier 3 is set in position, and over half of the permanent timber is in place. Dredging and concreting in the cells have not yet been commenced. The three pneumatic cylinders to constitute Pier 4 are under construction at the shipyard.

The work is in general charge of I. D. Waterman, construction engineer, New York, New Haven & Hartford R.R., New Haven, Conn., under Edward Gagel, Chief Engineer, and is supervised by P. B. Spencer, Division Engineer of construction, New London. Holbrook, Cabot & Rollins, of Boston, are the contractors and are represented on the work by L. S. White, Superintendent.

Excessive Water Waste in Grinnell, Iowa, is pointed out in a report submitted to the City Council by F. H. Crosby, City Manager. For the six months ending with October, 1916, the average quantity of water pumped monthly was 10,498,875 gal., of which 7,332,209 gal. were not accounted for. This is all the more noticeable since there are only about 80 flat-rate consumers in the city. There is reason to believe that a considerable amount of the unaccounted-for water escapes through so-called "¾-in. mains, practically all old and badly rusted." The exact length of such pipe is unknown, but is "fully 20,000 ft.," much of which, Mr. Crosby says, is "doubtless leaking badly." At the time of Mr. Crosby's report an investigation was being made of the possible waste of water through automatic sewer flush tanks, and instructions had been given to use the detectorphone in a house-to-house inspection.

Salt in the Streams in the oil districts of southern Kansas and northern Oklahoma is causing much complaint from cities utilizing the streams for domestic water-supply. Many of the oil and gas wells in this district discharge large quantities of salt water at more or less regular intervals, and practically all of the abandoned wells are flowing salt wells. The difficulty is of course accentuated at times of low flow in the stream, and ordinarily at times of high flow is scarcely noticeable. The water-supply at Sedan, Kan., on the Caney River, with an ordinary chlorine content of 10 to 25 p.p.m., reached 550 p.p.m. in October, 1913, and, according to the city officials, at times is even higher than that. In October, 1916, it reached 505 p.p.m. The supply at Caney and Cedarvale, Kan., on the same river, has approximately the same range of chlorine content. The new oil field on the drainage area of the Walnut River, which is utilized by the cities of Augusta, Douglass and Winfield, Kan., is apparently about to produce the same difficulty. Complaint has reached the Kansas State Board of Health from the water-works superintendent at Winfield and from various industries located there that almost pure salt is deposited at times in the boilers and on fixtures. It is probable that legislation will be asked for at the coming session of the State Legislature to enforce capping of all abandoned wells to prevent the discharge of salt water and to impound salt water discharged from producing oil and gas wells.

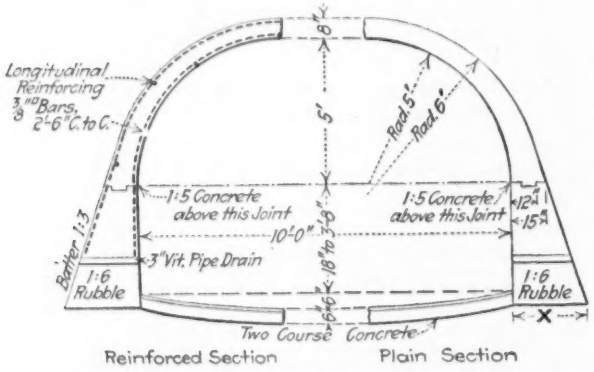
Building a Sewer in Creek Channel at Austin, Tex.

By Julian Montgomery*

In the early part of 1916 the City of Austin, Tex., appropriated $50,000 to build a storm sewer in the channel of Little Shoal Creek, so that it could be filled in and the streets blocked by it be completely opened to traffic. Alternative bids were asked for on (1) plain- and reinforced-concrete and (2) segmental-block construction. All bids on the segmental block were too high to be considered. The portion of the work here described consists of about 3400 ft. of 10-ft. sewer being built by the Dallas Lime and Gravel Co., of Dallas, Tex.

Excavation was begun by the contractor during the latter part of June, 1916. As there is a very small flow ordinarily, little trouble has been experienced from water in the creek. Since construction started, it has been unusually dry.

The method of construction being followed is to pour the bottom first. This bottom (see cross-section) consists of two-course concrete. The lower course is of 1:6 mix, 4½ in. thick. The topping is of 1:2½ mix, 1½ in. thick. The aggregate for the 1:6 concrete is a well-



SEWER CROSS-SECTION, AUSTIN, TEX.

graded unscreened gravel obtained from the Colorado River. That for the topping is specified to be what is locally known as "gutter gravel." It is a coarse sand with the largest particles about ½ in. in diameter. Since it is further specified that the topping shall be laid on the green concrete, the method usually followed is to pour about 30 ft. of the 1:6 concrete and then pour the topping directly on this. The lower course is kept the required 1½ in. below the finished grade by a templet that has been cut to the required shape and notched 1½ in. The topping is placed approximately to the required grade by spades. It is then accurately finished by a templet cut to the required section. After the pouring is completed, the bottom is floated and troweled. As it is considered the most important part of the sewer, particular care is being taken to see that it is built to specifications in every detail.

The completed bottom serves as a guide for the side walls. Outside forms are used for these. For the highest walls the outer and inner forms are wired together, and the inside ones are braced against each other. Plums of 10- to 50-lb. stone are allowed in the concrete in any quantity desired, provided there is 2 in. of concrete between them. Horizontal and vertical keyways are left in the tops and ends of the walls as a tie for the arch that comes upon them and to make a better construction joint between the sections of the walls that are poured each time.

The inside forms for the arch are hinged at the center. The outside forms are in two sections. A 2-ft. opening is left between them to receive the concrete and to provide ample space for cutting it.

Bracing the Outer Forms

The contractors have experimented at length on methods of bracing the outer forms. A trigger arrangement composed of a horizontal member, notched at either end and placed across the forms, with inclined struts fitting into these notches and bearing against the forms, was tried first. The main objection to this method was that the play in the joints of the forms was so irregular and of such a nature that the pressure was not distributed equally to each side of the trigger.

The next scheme devised was to brace the outer forms against the banks of the creek. This scheme, though slow, was usually successful. The only trouble encountered at all was due to a slight occasional yielding of the sides of the ditch.

Finally, it was decided to use three rows of bolts, two bolts in each row to the form, in connection with 4x4-in. longitudinal timbers. The timbers run the whole length of the forms, both inside and out; being tied together by the bolts, they constitute an effective bracing. This method permits the forms to be set up in the minimum length of time and is safe. Three-fourths inch bolts are used for the bottom row and ⅝-in. for the other two rows. The bolts are oiled well before being placed. When the concrete has set so that no pressure is exerted on the outer forms, the bolts are drawn. No trouble has been experienced except once or twice, when the workmen inadvertently bent some of the bolts. In such a case a Stillson wrench proved effective in twisting them out. The holes made by the bolts are left open.

Pouring the Plain-Concrete Sections

In the plain-concrete section the plans called for a 12-in. keyway to be left in the crown of the arch for at least 24 hr. after the rest of the arch had been poured. The purpose was to prevent shrinkage cracks. It was decided to pour some of the arch without the keyway and compare the cracks in it with those and in an adjacent section with a keyway. Accordingly the two sections, each 30 ft. long, were poured. Although the weather was very warm, a month of rigid inspection of the section without a keyway revealed no cracks. The section with the keyway, however, did not fare so well. At the construction joints of the keyway, fine cracks were discovered, first on one side and then on the other. Upon examination they were found to extend the thickness of the arch. It is well to mention that the faces of the keyway were sprinkled with water and covered with dry cement before it was poured.

In the light of the knowledge obtained, it was decided to leave the keyway out of all the plain sections, at the same time realizing that probably if the pouring of the keyway had been deferred until the arch had completely set, the cracks at the construction joints of the keyway

*Assistant City Engineer, Austin, Tex.

would have been practically imperceptible at the worst. Since then some 2000 ft. of plain-concrete arch has been run. Subsequent observations have shown a few short longitudinal surface cracks at rare intervals. These cracks do not extend over an inch or so into the concrete.

Where the construction joints are far enough apart, the arch cracks transversely about every 30 or 33 ft., the cracks proceeding in an irregular manner as directed by the line of weakest section.

At places where reinforcement is required, stubs are first placed in the side walls. After the inside form for the arch has been placed, the transverse steel is bent around it and tied to the stubs. Since the splice comes at the springing line, the outside steel is lapped 50 diameters and the inside 25 diameters. The steel is spaced away from the forms by small concrete blocks 1 in. thick made for that purpose. Longitudinal steel serves to keep the proper spacing betwen the transverse bars and is effective as a reinforcement against temperature stresses.

Other Features of the Work

Several interesting features of the work are noteworthy Due to the high cost of reinforcing steel, cement has been used as a reinforcing material as much as possible. All concrete is mixed for at least one minute in a Koehring mixer that turns 20 r.p.m. This is longer than concrete is mixed in the Southwest, as a rule, and probably the first time it has been done so in Austin on any work requiring a large quantity of concrete.

Another interesting feature is that the rock obtained from excavating to subgrade is placed on the intersecting streets for a block or two each way. This rock is a tough limestone and makes an excellent road metal.

It should be mentioned also that all forms are well oiled and that not a single honeycomb has been found next to the inside forms since the work was started. Many competent inspectors have said that the concrete is as good as they have ever seen.

The sewer was designed in the office of M. C. Welborn, City Engineer. The writer is the engineer in charge of the contract work and has immediate charge of the city force-account work. C. A. Newberry has charge of the construction for the Dallas Lime and Gravel Co.

New Standard Hydrant for Cincinnati

The Director of Public Safety of Cincinnati, Ohio, has adopted as standard the hydrant design illustrated in Fig. 1. This design is the work of J. A. Hiller, General Superintendent of the water-works, and its distinguishing feature is the curved standpipe *a* between the hydrant head and the main connection. This is shown in detail in Fig. 2. Another feature designed to prevent freezing of the hydrant is the drip valve *b*, which opens automatically when the gate is closed, thus draining the hydrant head and standpipe into a sump, which has a sewer connection.

The scheme of placing the standpipe, gate valve and connections in an accessible chamber is similar to the practice that has long been followed in Salt Lake City, Utah, described in *Engineering News*, July 13, 1916, p. 66. Exclusive of the chamber, it is stated that estimates of cost of hydrants of the new design are lower than new ones of the present standard type.

The hydrant head and curved standpipe are of cast iron. The 2½-in. and 4½-in. hose nipples are of bronze. The bolts and nuts are of wrought iron. The gate-valve seats and wedge are of bronze (of tensile strength of not

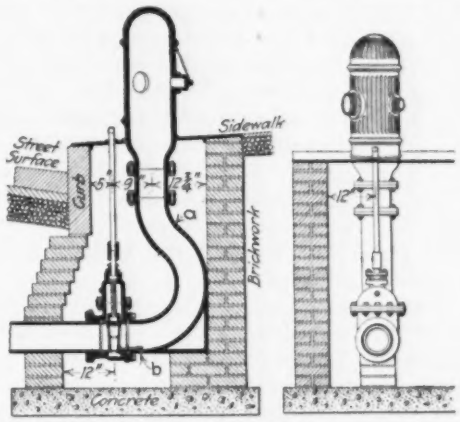


FIG. 1. NEW STANDARD HYDRANT, CINCINNATI, OHIO. WATER-WORKS DEPARTMENT

less than 30,000 lb. per sq.in.), and the stem and stem nut are of manganese bronze (of tensile strength of not less than 50,000 lb. per sq.in.). The stuffing-box is of brass. The drip valve is of bronze, with a ¼ x 1-in. leather-washer cutoff. The leather washer is held in place

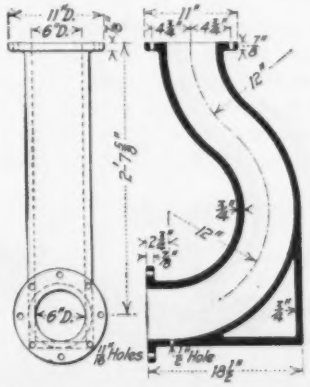


FIG. 2. DETAIL OF CURVED STANDPIPE, CINCINNATI HYDRANT

by a ⅜-in. wrought-iron washer and setscrew. The gate chamber is covered with a ⅝-in. cast-iron plate in two sections, 20½ in. and 44½ in. long respectively. The width of the cover plate is 39½ in.

Coal and Iron Production in the United States in 1916 exceeded all previous records. Approximate figures for the year's production announced by the United States Geological Survey show total shipments of iron ore from United States mines amounting to 75,500,000 gross tons. In 1915 the shipments were 55,493,000 tons. The value of the iron ore produced was $178,935,000, which is an increase of nearly $78,000,000 over the value of the iron ore produced in 1915. Of the total production more than 66,000,000 gross tons were shipped from mines in the Lake Superior district and about 5,300,000 from mines in the Alabama district. The total of pig-iron production will be between 39,000,000 and 39,500,000 gross tons. The year recorded an enormous rise in the market price. Southern foundry No. 2 iron at Birmingham rose from $13.13 to $22. Northern No. 2 foundry at Chicago rose from $18 to $29. Bessemer iron at Pittsburgh rose from $19.85 to $35.95. The bituminous coal production of 1916 is estimated by C. E. Lescher, of the United States Geological Survey, as over 509,000,000 net tons, an increase of more than 66,500,000 over 1915. The production of Pennsylvania anthracite was 88,312,000 net tons, which was about 600 000 tons less than in 1915.

Extending Piers for Double-Tracking B. & L. E. Allegheny River Bridge

The heavy new double-track bridge of the Bessemer & Lake Erie R.R. over the Allegheny river 14 mi. north of Pittsburgh (see *Engineering News* of Feb. 15, 1917) will make use of the five main piers of the existing single-track bridge. As the foundations for these were originally put in with eventual double-track construction in view, the substructure contractor had only to add to them a 32-ft. downstream extension of the shaft proper, except in the case of one pier, where the load is to be so greatly increased that the foundation required reinforcement. Two other piers, Pier A and Pier B, and the abutment at the south end are new.

The north approach viaduct is to be replaced in part by 1200 ft. of high embankment, previously described, and the remainder by two deck truss spans of the new bridge. One of these spans (Pier A to Pier B) will be a simple truss 153 ft. long, and the other (Pier B to Pier 1) will be the end span of a series of three continuous truss spans, 972 ft. long. Another such triple continuous truss, 1142 ft. long, will comprise the rest of the steelwork.

The new Pier A, at the north end (Fig. 1), will be almost buried by the completed fill. It is practically an abutment and is designed to take a considerable thrust from the fill. The foundation is one block of concrete, 78x32 ft. in plan, resting on hard gravel 28 ft. below ground; but to decrease the surface subjected to pressure by the fill, the pier proper is constructed with two shafts, joined at the top by an arch. The shafts are entirely of concrete; the cut-stone masonry facing, of Beaver Valley sandstone uniform with the other piers, has been used only from a point just below the springing line of the arch to the top. The surface of the completed fill will intersect the face of the pier somewhat above this springing line.

Pier B is the "anchor pier" for the continuous superstructure. Its shaft is 50% thicker than that of any other of the piers, and its spread foundation is 62x89 ft. in plan, with offset steps, each reinforced by horizontal steel rails. It rests on good compact gravel. The construction of Pier B was very much complicated by the fact that one viaduct tower came directly over the site.

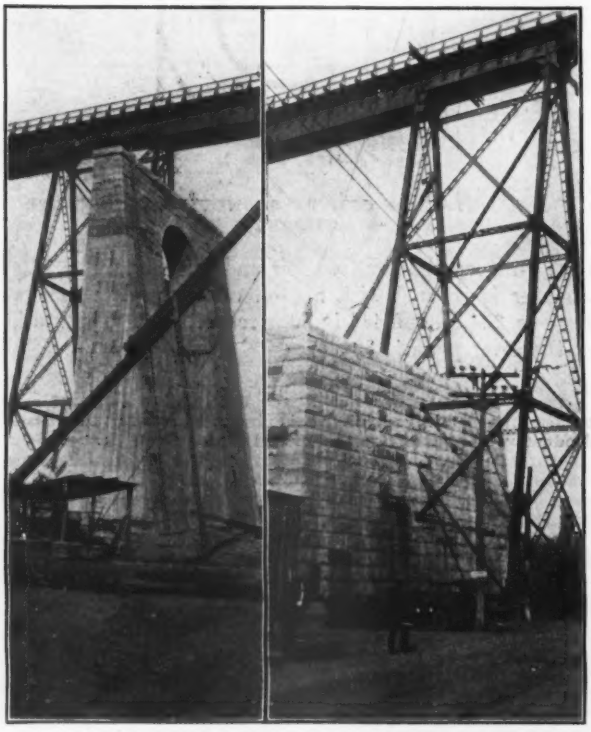


FIG. 1. TWO-PART PIER IN APPROACH FILL (PIER A)

FIG. 2. PIER B BEING BUILT AROUND VIADUCT TOWER

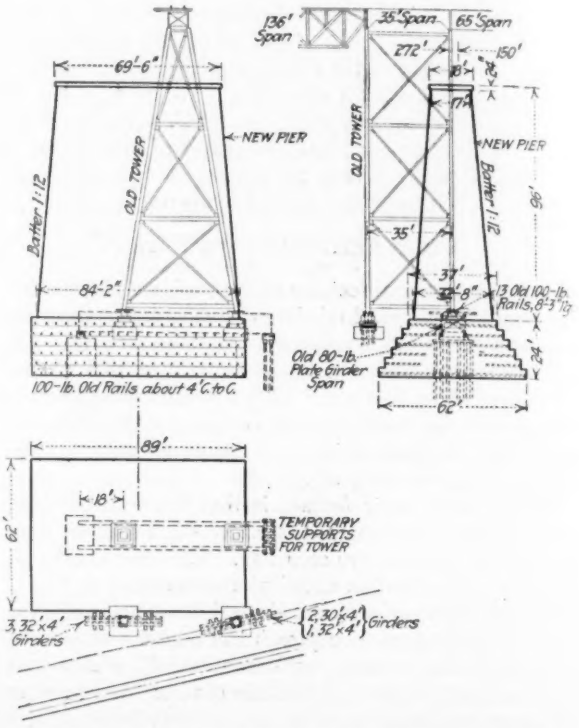


FIG. 3. PIER B AND SUPPORT OF VIADUCT TOWER

This was particularly troublesome during excavation for the footing, as adequate support for the structure had to be maintained at all times. When it came to building the shaft of the pier, the steelwork was simply concreted into the work (see Fig. 2). When the old bridge is dismantled, the steel will be cut off back of the pier face, and the openings in the facing will be filled with cut stone.

Fig. 3 illustrates how the support of the viaduct tower was handled while the footing was built. A concrete shaft inside the sheeting for the excavation and a pile cluster outside the sheeting were first constructed. Two old 80-ft. girders, reinforced for the column concentrations, were maneuvered into place from each side of the trestle bent and joined by bracing. Cribbing of 20-in. I-beams and 100-lb. steel rails were then placed under the shoes to transfer the pedestal loads to the girder span. The other bent of the tower came just outside the edge of the excavation, but to prevent possible trouble this was also carried on pile clusters, capped by small plate girders.

The long truss spans of the old bridge terminate at Pier 1, which therefore carried the end reaction from only one span, besides the trifling load from the first span of the viaduct. In the new bridge this pier will support

the load from two spans of the heavy continuous structure, and so its foundations, although already of double-track width, required reinforcement.

There were already in place 280 timber piles; it was decided to add to these 126 concrete piles, two rows along each side of the old footing and one row across the downstream end. A cofferdam of United States steel sheetpiling was driven entirely around the pier. Excavation was then carried to the bottom of the capping over the old timber piles, and Cummings precast piles were driven on 3-ft. centers, as close to the old footing as possible. The footing block was enlarged, using 1 : 2½ : 5 concrete, to the dimensions shown. The portion of the footing masonry not under the existing pier shaft

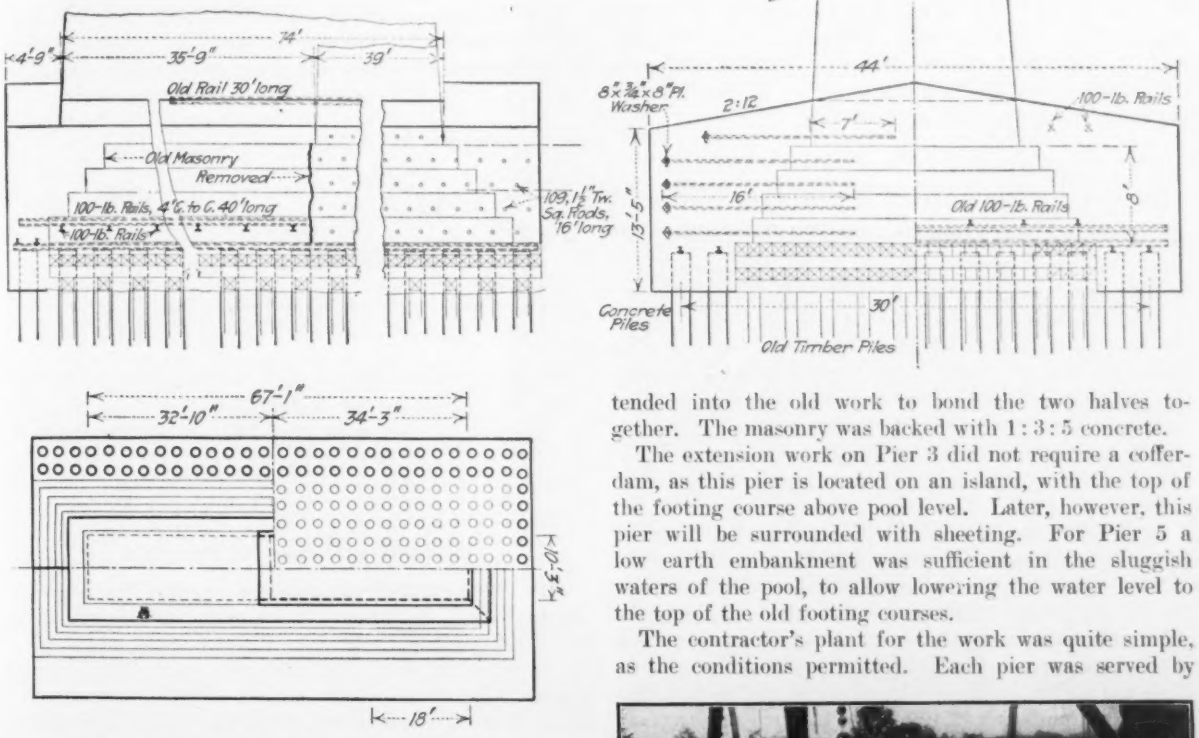


FIG. 4. FOUNDATION REINFORCEMENT, PIER 1

was removed down to the timber grillage, so that a monolithic footing, reinforced with a mat of steel rails, could be constructed over both old and new piles. In the other half of the footing the new work was bonded to the old by 1½ in. square twisted rods, 16 ft. long. These were set in horizontal holes, drilled on about 2-ft. centers into each course of ashlar masonry, and carried heavy plate washers, held in place with double nuts, at the end embedded in the new concrete. The placing of these rods necessitate widening half of the cofferdam.

Cofferdams were required at Piers 2 and 4 to get at the old footing extension, so as to carry up the masonry in the dry. These footings had been carried up to low-water level at the time they were built, but since that day a Government dam in the Allegheny below the bridge site has raised the water about 4 ft. for full pool. It is the intention to surround each of the piers (except No. 5, which is on rock) with 30-ft. steel sheeting driven down to a few feet above the top of the timber grillage. Instead of driving this sheeting entire and using it is a cofferdam for the masonry work, the contractor chose to drive only the half actually required at first, sealing the upstream end against the pier. The reason assigned was that pumpage would be reduced. The steel sheeting for the first half-dam was driven with a steam hammer hung from a stiff-leg derrick. For completing the sheeting a land piledriver was rigged up on cribbing on a barge, with leads overhanging the water.

In building up the pier extensions the corner stones of the old pier were removed in every other course, the headers being taken out and a stretcher of the new course extended into the old work to bond the two halves together. The masonry was backed with 1 : 3 : 5 concrete.

The extension work on Pier 3 did not require a cofferdam, as this pier is located on an island, with the top of the footing course above pool level. Later, however, this pier will be surrounded with sheeting. For Pier 5 a low earth embankment was sufficient in the sluggish waters of the pool, to allow lowering the water level to the top of the old footing courses.

The contractor's plant for the work was quite simple, as the conditions permitted. Each pier was served by

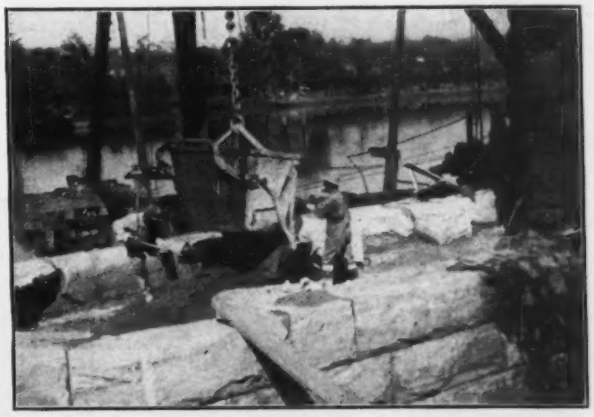


FIG. 5. CONCRETE FILLING IN PIER EXTENSION

one or two stiff-leg wooden derricks, which were used in the successive operations of piledriving, excavating (when necessary) and the handling of concrete, backfilling and cut-stone masonry. The exception to this was in the building of Piers A and B, where concrete was placed in both from a single tower. There was one mixer plant for this tower and another across the highway, and West

Penn electric-car tracks, near the bank of the river. Running from this shore across to Pier 4 was a service trestle consisting of three-pile bents spaced 12 ft. and carrying four 10 x 12-in. stringers. A narrow-gage track was laid on this trestle, with a siding between Piers 2 and 3 (on the same three-pile bent construction). Dump buckets loaded at the shore plant were run to the pier sites on flat-cars, where they were handled to the work by the stiff-leg derricks. A separate mixer plant was set up across the river at Pier 5, but it was found more economical to ferry the concrete across the river from the end of the trestle on a barge carrying a couple of bottom-dump buckets. This was due to the fact that but one course of masonry was placed at a time, and was then concreted.

The south abutment is being constructed by railroad-company forces. The reconstruction is under the supervision of H. T. Porter, Chief Engineer of the Bessemer & Lake Erie R.R. W. H. Slifer is Resident Engineer. The substructure contract is held by the Arthur McMullan Contracting Co., of New York City.

Irrigating Seventeen Thousand Acres of Municipal Land

By C. C. Cragin*

Active construction work has been in progress for some time on an irrigation system of 17,000 acres, owned by the City of Las Vegas, N. M., and adjoining its city limits (Fig. 1). This area comprises all that remains unsold of what is known as the Las Vegas land grant, which originally consisted of 475,000 acres, the administration of which is under the control of a Board of Trustees.

Numerous attempts have been made during the past 10 years to finance this irrigation project; but notwithstanding the fact that the irrigable land is contiguous to a community of over 11,000 people, litigation involving the title to the land and water rights has heretofore prevented interesting capital for development of the enterprise. With the uncertainties of title removed and capital provided, the completion of this project, which means much to the City of Las Vegas, is now assured.

The project contemplates the diversion of waters from the Gallinas River and the Sanguijuella and Pecos Creeks, which have a drainage area of 165 sq.mi., extending to an elevation of 12,000 ft. The flow of the Gallinas River is particularly adapted to diversion, being entirely free from the sudden floods common to most New Mexico streams. The snow in the high mountains, lasting each year into August, acts as a regulator, and the flow in the flood seasons rarely exceeds 500 sec.-ft., thus permitting practically 100% diversion. Accurate stream gagings have been conducted by the United States Geological Survey on the Gallinas River for a period of 12 years and show an average annual runoff of 22,000 acre-feet. This represents 90 sq.mi. of the total of 165 sq.mi. of drainage area available. The water is to be diverted through diversion canals to a storage reservoir on a branch of Sanguijuella Creek, for over-year storage.

The diversion dam in the Gallinas River, now completed, has timber flashboards spanning concrete piers with headworks consisting of eight 5 x 5-ft. by ⅜-in. steel gates. The Gallinas diversion canal is 12,500 ft. long, 30 ft. wide on the bottom and 8 ft. deep, with 1½ to 1 slopes. It has a capacity of 1000 sec.-ft. and required 110,000 cu.yd. of earth and rock excavation. This was completed in time to divert the runoff from the fall rains.

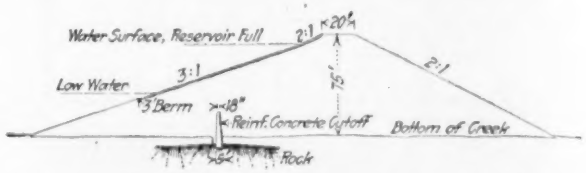


FIG. 2. CROSS-SECTION OF SANGUIJUELLA EARTH-FILL DAM FOR LAS VEGAS IRRIGATION PROJECT

Earth Dam Under Construction

The storage reservoir, known as the Sanguijuella reservoir, will be formed by an earth dam 75 ft. high and 1400 ft. long, with 3 to 1 water slope and 2 to 1 air slope (Fig. 2). The upstream face is to be riprapped 9 in. thick. There will be 450,000 cu.yd. in the 75-ft. dam, when completed, of which about one-third has already been placed. The material is heavy clay, mixed with a good proportion of sand and gravel. It is being excavated by a 40-ton Vulcan shovel, with 1½-yd. dipper. The borrow pit is 5000 ft. from the dam, with a downgrade haul. The material is hauled in 4½-yd. dump-

FIG. 1. LOOKING OVER LAS VEGAS, N. M., TOWARD LAND TO BE IRRIGATED BY NEW PROJECT

*Dockweiler & Cragin, Consulting Engineers, San Francisco, Calif.

cars and side dumped from tracks laid on the two slopes, where it is sluiced by jet into place, toward the center of the dam. The water-supply is obtained by gravity, through the diversion canal, from the Gallinas River. A reinforced-concrete cutoff wall is being constructed to solid rock, between high water on the north end and high water on the south end of the dam. It varies in width from 5 ft. at the bottom and 18 in. at the top to a minimum of 12 in. thick. The maximum height is 31 ft. Concrete is being placed by gravity through 12-in. steel chutes from a ¾-yd. portable mixer. About 500 ft. from the south end of the dam a low saddle permits the construction of a spillway 100 ft. wide, with a maximum cut of 4 ft. Outcropping rock, below the spillway, forms a natural cascade for overflow water.

There will be a gate tower 10 ft. square and 50 ft. high, founded on solid rock and connected by a bridge to the north haunch of the dam site. The outlet is a concrete arch culvert 212 ft. long, excavated through solid rock in the north haunch of the dam and bonded directly with the cutoff wall. It will be 5 ft. 6 in. wide by 4 ft. 6 in. high in the clear. The excavation is now completed and ready for concrete.

The capacity of the reservoir above the outlet is 23,100 acre-feet, and the area at this capacity is 1100 acres. Provision is made for raising the dam at some future date. The final height will be determined definitely when authentic stream gagings of Sanguijuella and Pecos Creeks are available. These streams can be diverted into the reservoir over a low divide by small diversion dams and canals, 1 mi. and 4 mi. long respectively. When the amount of this additional water is determined, some privately owned land will be brought under the ditch. The main canal will be 18 mi. long and contain about 300,000 cu.yd. of excavated earth and rock.

Other Structural Details

There will be two reinforced-concrete inverted siphons, one under Sanguijuella Creek and one under Pecos Creek. There will be approximately 1200 ft. of steel flumes, with a maximum height of 25 ft. There are approximately 30 mi. of laterals to construct.

An electric generating system for electric lights is now being installed at the dam. When completed, construction work is to be carried on by day and night, insuring completion of the project by the coming spring.

The land to be irrigated starts immediately at the toe of the dam, permitting the gradual decrease in the size of the canal and canal structures after the first headgate, a few hundred feet from the dam. The head of the canal is 5 mi., and the most remote farm on the project 6 mi., from the business district of the city. Fall plowing on a few small tracts, for demonstration purposes, was done, and it is planned to have water available for irrigation by spring.

R. C. Storrie & Co., San Francisco contractors, have undertaken the financing of and construction work on the irrigation system, the Board of Trustees of Las Vegas having shown their faith in the project by taking bonds to the extent of $200,000. Prominent local interests have subscribed for about $25,000 more. The estimated cost of construction, including all necessary laterals, is approximately $500,000. Dockweiler & Cragin, Consulting Engineers, of San Francisco, have been intrusted with the engineering details of the project.

New Jersey Introduces Small Granite Cubes for State Road Paving

The small granite-cube pavement known under the trade name of "Durax" has at last made its entry into this country as a rural-road pavement. It has already been used to a limited extent as a city pavement, but its original purpose, when it was several years ago introduced in Germany and England, was for surfacing rural roads with something more durable than macadam. The following information was furnished by R. A. Meeker, Engineer of the New Jersey Department of Public Roads:

The reason for the adoption of the Durax pavement was that it was not possible to reduce the grade below 7% without considerable injury to adjoining property. It was therefore necessary to adopt some form of block pavement that would not be slippery at this grade. Investigation led to the adoption of the Durax block for this purpose.

The stretch paved is on a part of the Morristown turnpike forming the boundary line between Short Hills

DURAX GRANITE BLOCKS ON MORRIS TURNPIKE AT SUMMIT, N. J.

and Summit. It is 1200 ft. in length and 24 ft. in width. The roadway was prepared by grading the subfoundation to a depth of 10½ in. below the established finished grade and crown. This subgrade was thoroughly consolidated by rolling with a three-wheel roller.

On the prepared foundation there was spread 6 in. of concrete, composed of one part of portland cement, three of clean, sharp sand, free from loam, and five of broken stone. The consistency of the mixture was such that, when rammed, it would not shake like jelly or be displaced laterally with the rammer. It was further required that the rammer must be perfectly flat, so as to secure a smooth surface.

When new concrete had to be laid to connect with sections already set, or partly set, the edge of this latter section was broken off, freed from dust or dirt and properly dampened. Great care was taken to make the surface of the concrete exactly parallel to, and 4½ in. below, the surface of the finished pavement.

Owing to the fact that the concrete was laid late in the fall, it was protected from the effects of the weather, first, by sprinkling in warm weather between the hours

of sunset and sunrise, and second, when the weather became cold, by covering with a thin layer of sand. All carting over the concrete was prevented until it was sufficiently set, and then only when it was covered with planks. Watchmen and barriers against traffic, at all hours of the day, were maintained at the contractor's expense.

The concrete was allowed to set for six days. Upon the concrete foundation a bed of clean, sharp sand, free from loam, gravel or other impurities, was spread to such a depth as to bring the pavement to the proper grade and crown when rammed, and in no case was the depth of sand allowed to be less than 1½ in.

On this layer of sharp sand the granite cubes were laid close to and in contact with each other, so that there was no joint of over ½ in. These cubes were laid so as to break all joints and in concentric arcs. After the cubes were laid as specified, there was spread over the surface ¼-in. screenings, to fill all joints flush to the surface of the cubes. The cubes were then thoroughly rolled with a small tandem roller weighing five tons, until they were brought to the established finished grade and crown at all points.

The Durax blocks are cubes of medium-grained granite. The granite was such as would give at least 20,000 lb. per sq.in. crushing strength combined with a uniform structure and a toughness of 12, as determined by the method of the United States Office of Public Roads and Rural Engineering. The cubes have the following dimensions: All six surfaces approximately square; the edge of the cubes not less than 3 in. or more than 4 in.; the cubes used in any one course not to vary more than ½ in. in size.

After the pavement had been brought to a uniform surface, grout was poured into the joints. Immediately afterward the entire pavement was broomed to a smooth surface, sufficient grout being applied to bring the surface even with the highest part of any of the blocks. The blocks were wet by sprinkling immediately before applying the grout, in order to permit a perfect bond between the blocks and the grout.

The grout was composed of one part of the best quality of standard portland cement and one of clean, sharp sand. The grout was mixed in a box resting on legs of different lengths, so that the mixture readily flowed to one corner of the box, the bottom of which was 6 in. above the pavement.

The mixture was removed from the box to the street surface with scoop shovels, all the while being stirred in the box to prevent segregation. The work of filling the joints was thus carried forward until an advance of 15 or 20 yd. had been made, when the same force and appliances were used to regrout the area in the same manner, excepting that the proportion of the second mixture was two parts of portland cement to one part of sand.

In order to avoid the possibility of causing the grout to become too thick at any point, one workman sprinkled the surface ahead of the sweepers, to insure the penetration of the grout in the joints of the pavement; and to further insure this penetration, squeegee scrapers, 15 to 18 in. in length, were used in addition to the brooms on the last application of the grout.

Within one-half to three-quarters of an hour after the last coat of grout was applied, when the grout between the joints had fully subsided and the initial set had taken place, the whole surface was slightly sprinkled and all surplus grout left on the top was swept into the joints, bringing them up flush and full. After the grouting was done and a sufficient time for hardening had elapsed, so that the coating of sand would not absorb any moisture from the mixture, ½ in. of sand was spread over the whole surface, and the pavement was kept sprinkled until the grout had had an opportunity to set thoroughly.

After the grouting was completed, the road was kept closed and no carting or traffic was allowed over the pavement for 10 days. The contractor was required to erect and maintain strong barricades and furnish watchmen at all times to insure the exclusion of traffic and carting.

One portion of the work was not grouted until freezing weather came on; and in order to complete the work, a bituminous mastic was used in place of the portland-cement grout, with apparently as satisfactory results as in the first method.

The contract price of the pavement was 75c. per sq.yd. for the concrete base and $2.50 per sq.yd. for the Durax block pavement, making the total cost of the work $3.25 per sq.yd., or out of all proportion to the usual cost of country road pavements. The contractor was C. E. McDowell, Newark, N. J.

Experiments with Concrete Ties at Riverside, Calif.

By J. H. G. Wolf*

The following is the record of a test of hollow concrete ties in railway track, which began in October, 1913, and has been continued up to the present time. The design of the tie (which was patented by the writer, Aug. 22, 1916, No. 1,195,634) is shown in the accompanying drawing and photographs, Figs. 1 and 2. The object of the hollow form is to obtain lightness and resilience, and the results have justified that expectation. The outward shape is kept close to that of the wood tie, so that replacements can be made in present track.

The method of rail attachment used is such that the attaching medium is entirely free of the tie structure itself. This has apparently proved practicable and economical. A screw spike passes through an opening in the rail seat into a loosely inserted block of wood some 18 in. long, within the tie. The thrust on curves and from swaying train equipment is thus taken on the upper surface by the cushion block against the raised shoulder, and on the interior by the upward thrust of the block against the concrete surface. This mode of attachment has met the conditions of service and appears to provide a protection against rail spreading which cannot be obtained with a spike or bolt buried solidly in the concrete.

Preceding the main construction, about ten full-sized ties were made for preliminary tests and service trials. The tests in the laboratories of the Department of Civil Engineering, University of California, showed that ties reinforced with four ⅜-in. rods, together with the Clinton wire cloth and the netting, could with center loading be expected to show a breaking strength of 13,000 lb. and an elastic deflection of about ⅜ in. Test ties

*Mills Building, San Francisco, Calif.

placed in a freight yard in Oakland suffered the loss of the outer shoulders almost immediately, which stopped the experiment in the first week. These shoulders were but ½ in. high; those of the ties afterward made are 1 in. high and have not been injured.

The foregoing work was done in 1911, after which a contract was made with a local cement company to take

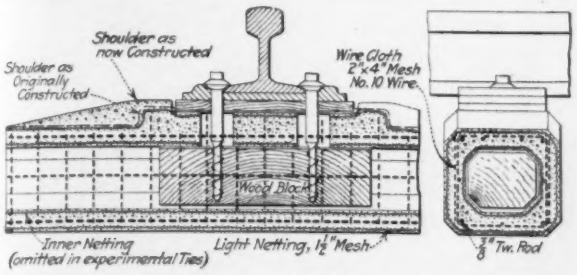

Shoulder as now Constructed
Shoulder as Originally Constructed
Wire Cloth 2"x4" Mesh No. 10 Wire
Wood Block
Inner Netting (omitted in experimental Ties)
Light Netting, ½" Mesh
⅜" Tw. Rod

FIG. 1. WOLF HOLLOW REINFORCED-CONCRETE TIE

up the matter. About 120 ties were cast in August and September, 1913, and about 60 of these, seen in Fig. 2, were placed in the track in October 1913. They have been there ever since, except for a few removals for minor failures. The ties are 7x8 in. in cross-section and 8½ ft. long. They have 1½-in. walls, increased to 2 in. under the rail seats, except that a few have straight 2-in. walls throughout. The average concrete is a 1:2:3 mix.

The stretch of 200 lin.ft. of track comprised in the experiment is on the Riverside, Rialto & Pacific R.R. at Riverside, Calif., which line carries an interurban high-speed electric service in addition to an intermittent but heavy-weight steam railway service. Trains with 87-ton locomotives hauling 20 steel cars loaded to capacity with cement (and weighing up to 70 tons each) pass over this track at high speed to overcome a 2% grade into Riverside. The ties are at the foot of this grade. The embankment is some 10 ft. high, of clay, and in the rainy season is inclined to yield. The ballast is gravel. The rails are light (60 lb. per yd.). Cushion plates of hard oak, 1 x 8 x 12 in., are used instead of unplaned spruce boards, as designed. Plain flat steel plates take the place of regular tie-plates, and common lagscrews are used instead of the more suitable screw spikes.

A few of the ties have split on the ends at the upper surface, owing possibly to expansion stresses. The outer

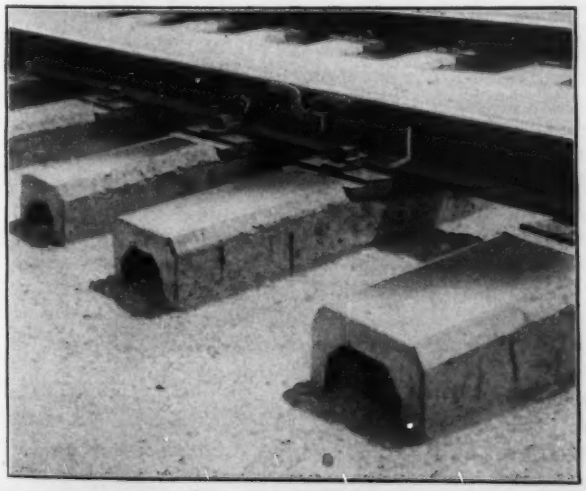


FIG. 2. WOLF REINFORCED-CONCRETE TIES IN PLACE

netting envelope was designed partly to safeguard against this contingency, but was not used in these ties. The concrete under the rail seat of one or two ties is reported to have given way; all other ties are reported to have stood up well during the three years of severe service.

The most noticeable effect of the pounding the ties have received is shown in the tie-plates. The steel plates as well as the hardwood cushions have both cracked and split in numerous instances. This defect has apparently not yet vitiated the experiment. In reviewing results, however, it should be considered, as well as the difficulty of obtaining uniform concrete work at the outset and the difficulties of manipulating properly the metallic reinforcement until the men were familiar with the work.

The riding qualities of the stretch of track on the new ties are pronounced excellent by the trainmen. The swaying of the train, characteristic of the lighter wood-tie track, disappears on the new, and the resilience ob-

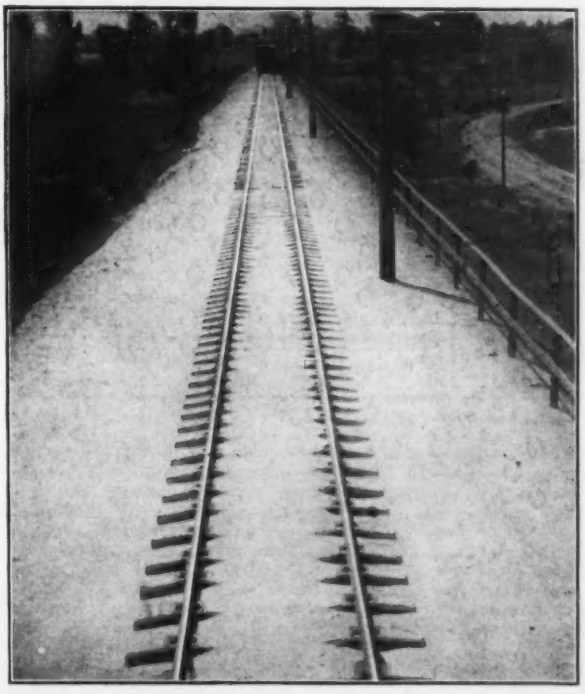


FIG. 3. VIEW OF TRACK WITH WOLF TIES

tained makes riding easy. The ties are light enough (320 lb.) to be handled by two men and have less tendency to bury themselves in the ballast than solid concrete ties weighing 500 to 600 lb.

The quantity of materials needed to make up the tie compares favorably with previous designs for a composite tie, being but 0.08 cu.yd. of concrete and 32 lb. of steel reinforcement for the ties with 1½-in. walls. No difficulty was experienced in fabricating collapsible forms. No cost statements are offered, as unit costs vary the country over and with each individual's capital and facilities for doing work economically. The railroad, with its gravel bank and inexpensive common labor and seeking ordinarily to equalize seasonal employment for this labor, is in the best position to profit from an encouraging development of this character.

Acknowledgment is due the Riverside Portland Cement Co. for assistance in the experiments and to the railway officials for the opportunity of making the tests.

Trees Planted by New Machine Replace Railway Snow Fences

By Hugh Smith*

The Minneapolis, St. Paul & Sault Ste. Marie Ry. is making extensive experiments in tree planting, to form windbreaks in place of snow fences. A large nursery has been established by the railroad at Drake, N. D. A planting plan for the right-of-way at the railroad cuts has been evolved.

The planting plan is as follows: On the north side of each cut, eight rows of trees are placed. On the south side of the same cut only four rows of trees are planted, as shown in Fig. 1. The rows are 8 ft. apart, and the trees within the rows are from 3 to 4 ft. apart. The outside row, or the row farthest from the tracks, consists of a planting of carragana; the next row is planted with poplars; the remaining rows are planted in the following order: Green ash, box elder and four rows of willows.

The four-row planting on the south side of the cut is arranged as follows: The outside row is planted to carragana, the next row consists of poplars, and the

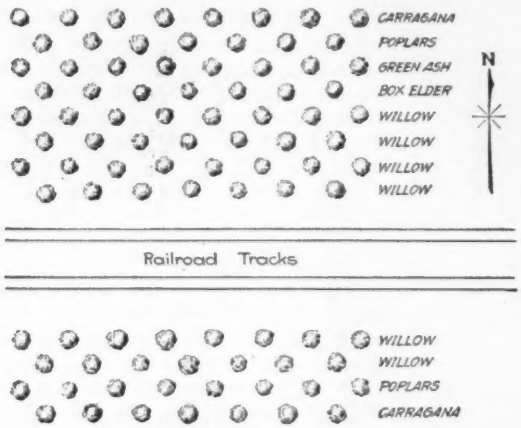


FIG. 1. PLANTING PLAN FOR WIND BREAKS FOR RAILWAY CUTS

three remaining rows of willows. The variety of willow best adapted for this planting is the laurel-leaf willow (*Salix pentandra*). This variety seems to be more free from disease and from insect injuries than other varieties.

This planting plan has not yet been adopted as standard, inasmuch as extensive tests are being made at the Drake nursery with different varieties of trees and shrubs, to determine if possible other species well adapted to the environment.

The tough sod of the virgin prairie is first plowed and then gone over with a disk harrow (see Fig. 2). This is followed by a deeper plowing and by a second disking. The preparation of the land in this manner entails the use of a large amount of labor.

The trees are not planted until one season after the foregoing operations have been completed. The tree planting was at first done by hand. Twelve men in a 10-hr. day working under average conditions planted approximately 2000 trees. The total cost of this planting, taken from accurate cost records, is 1.66c. per tree.

Many disadvantages are inherent in the hand method of planting; labor is a paramount consideration. Men who will give the planting sufficient care are difficult to obtain. The entire method is slow, and only a few miles of track can be planted each year. T. A. Hoverstad, Agricultural Commissioner of the Minneapolis, St. Paul & Sault Ste. Marie Ry., was keenly aware of the defects existing in the old method of planting. He saw the need of a machine of some sort to do the planting, and he has developed one that is a striking success.

This device is shown in Fig. 3. The main part is simply a subsoil plow. Sideboards of steel are attached to the plow and extend to the rear. The space between

FIG. 2. PREPARING PRAIRIES FOR TREE PLANTING

these steel plates is 6 in. Two small plates that act as scrapers are located immediately in back of the large sideboards. Back of the scrapers are two wheels. These are set at an angle, each slanting in. These wheels press the soil about the newly planted trees.

The machine is surmounted by a platform that holds three men. Two men do the planting, and one man drives the team. The machine is made so that the weight of the platform and the men on it is thrown on the two wheels in the rear. Fig. 4 shows the machine in operation. A man walks on each side and hands the trees to the men seated on the platform. The men, working alternately, place the trees in the opening made by the machine. The scrapers throw the dirt back into the opening, and the rear wheels pack the soil.

The machine was given a thorough trial and proved to be satisfactory. During the past season it has given efficient service under constant use. The day's work includes moving from one railway cut to another and does not embrace any long period of steady planting. It is estimated by the men in charge that under good conditions, where steady planting may be pursued, 20,000 trees could easily be placed in a day. The cost of planting under the new method averages 0.2c. per tree.

Two machines have been made since the first model. These will be used next season, so that there will be a total of three in use by the company. These later machines have a few minor changes, but adhere closely to the original model. The inventor is contemplating additional improvements in the land-preparation method, which will further reduce the planting cost.

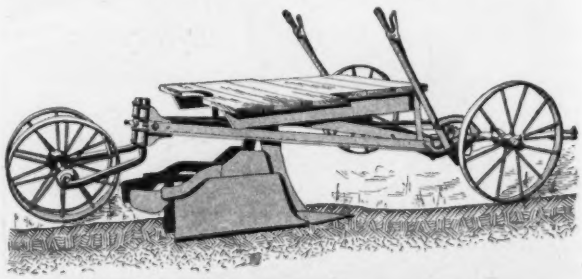


FIG. 3. HOVERSTAD TREE-PLANTING MACHINE

*326 West Minnehaha Boulevard, Minneapolis, Minn.

FIG. 4. TREE-PLANTING MACHINE IN OPERATION

The tree-planting machine is adaptable to many uses. Other railroads, both in the East and the West, have taken an active interest in the work and are planning to adopt similar methods upon their lines. Owners of large estates, orchardists, nurserymen and others having extensive plantings to make will find the machine invaluable. It also offers an opportunity to undertake planting work in townships and also farm plantings under the community plan. The machine promises to be an important factor in the reduction of labor costs in many branches of forestry and nursery work.

Proposed Pacific Coast Highway

By F. W. Harris*

The industrial development on the Pacific Coast has shown the necessity for a highway along the coast, both for military and economic purposes. Unlike the Atlantic Coast the harbors of the Pacific are isolated, as the foothills of the Coast Range extend to tidewater, making very costly the construction of a road adequate for motor-truck service.

Along the Oregon coast the pioneers for many years have been running stage lines on the beaches, according to a schedule based on the nautical almanac. This crude method has given satisfaction, owing to the sparseness of the population.

With the development of such harbors as Gray's and Willapa in Washington, Coos Bay in Oregon and Humboldt Bay in California, the need for a connecting road has long been felt. It is probable that the great stimulus given to the building of wooden ships in these harbors will result in connecting these points with a highway.

Adjacent to these harbors are millions of feet of timber suitable for the manufacture of wood pulp. The question of power for these mills is one of choice between hydro-electric and steam. Coal deposits are very extensive, and with adequate transportation facilities the cost of steam power will compare very favorably with hydro-electric power so far as the average industry is concerned.

The proposed Pacific Coast highway is the first effort made to connect all the harbors on the coast with a modern road; this must be regarded as the first step in industrial development. From a military viewpoint the most important section of this road is between Coos Bay, Oregon, and Eureka, Calif. This section skirts the great barrier of the Siskiyou Mountains, which block the existing Pacific highway on the Oregon-California line.

This coast-line road has one distinction that will make it unique. Along the shores of the Pacific Coast is the only place in the world where a road can be built running in a north and south direction between the thirty-third and the forty-ninth parallels of latitude, which would be free from snow during the entire year. The suggested name for this coast-line road is the Balboa Highway.

*Renton, Wash.

Handling the Cost of Railway Grade Reductions in Accounting

The rules of the Interstate Commerce Commission require railway companies to charge the value of abandoned property to operating expenses. Some of the controversies over this ruling were reviewed in a paper read before the Western Railway Club, on Jan. 17, by Frank Noy, Comptroller of the Chicago, Rock Island & Pacific Ry. A part of his paper follows:

The classification provides that when property is retired and replaced, the original cost thereof, less salvage, shall be charged to operating expenses. This means that if a road makes a cutoff, abandoning part of a curve and shortening the line, the original cost of the old road, less the salvage, shall be charged to operating expenses.

This ruling was contested by the Kansas City Southern Ry., which, in changing its line some years ago, did actually abandon many portions of curves. They left the cost of the old property in the property account, where many railroad accounting officers and executives think it should remain, and the Interstate Commerce Commission brought action against the road to compel it to charge off the original cost of such abandoned roads. The decision was against the railroad, and it has had to make the charges as required by the classification.

Such a rule, however, brings about this situation: If it is decided to reduce the grade of a line by cutting down the humps and filling in the low places in the track, doing the work on the old right-of-way, the entire cost of reducing the grade is chargeable, under this rule, to the capital account. However, if it is decided to reduce the grade by abandoning a certain portion of the line and constructing a new line entirely, the effect of charging the cost of the abandoned line to operating expenses means that a very large portion of the cost of reducing the grade in that way is chargeable to operating expenses. In other words, if the work is done vertically, the charge is to capital account; if it is done laterally, the charge is to operating expenses.

How To Turn Rubbish to Riches is the alluring title of the "Plaindealer's" story (Cleveland, Ohio, Jan. 15, 1917), based on a report on a "survey" of waste collection and disposal in Cleveland. The survey was made by a committee of the City Council and Chamber of Commerce, headed by John P. Becker and David E. Green respectively. The committee submitted the following ten recommendations:

1. That the householder be educated in the proper method of disposing of waste and the forcing of him to comply with the law.
2. That a regular schedule be maintained for the collection of all waste.
3. That a standard type of receptacle be required for rubbish.
4. That the dumps have watchmen stationed on them at all hours and that the owners of private dumps be required to employ watchmen when filling takes any length of time.
5. That the hucksters who dump waste in the streets be prosecuted.
6. That the city pick the dumps.
7. That the city purchase the land to be filled whenever possible and charge for the material furnished to fill private property.
8. That all of the dumps be soaked with oil and burned, and then burned every week thereafter.
9. That a central loading place be established for manure, so that it can be shipped to farmers.
10. That the City Council appropriate $5000 for the purpose of employing some sanitary engineer to work out the most economical and sanitary method of collecting and disposing of the city's waste.

The present system of garbage disposal by reduction is approved, but the report says that the cost of collection in Cleveland is $3.02 a ton, compared with $2 to $2.50 elsewhere.

Engineering Literature

Valuation and Related Problems

REVIEWED BY FREDERIC P. STEARNS*

VALUATION, DEPRECIATION AND THE RATE-BASE—By Carl Ewald Grunsky, Eng. D., M. Am. Soc. C. E.; assisted by Carl Ewald Grunsky, Jr., E. M., M. Am. Inst. Min. E. New York: John Wiley & Sons, Inc. Cloth; 6x9 in.; pp. viii + 387; illustrated. $4.

This volume is a notable addition to the small number of books that treat at all fully the subject of valuation and related problems. It contains an introductory discussion; carefully written definitions of many of the terms used; a statement of fundamental principles; a full discussion of the various matters that affect valuation and rate making; chapters relating to the value of real estate, water rights and reservoir and watershed lands; a special chapter by Carl Ewald Grunsky, Jr., on the valuation of mines and oil properties, which includes tables of the production and price of various metals for each year since 1880; tables giving the probable useful life of various articles and expectancy of life and remaining value upon a given theoretical basis; and a series of tables relating to compound interest, present worth, annuities, amortization and depreciation, which cover a wider range of interest rates and length of life than is usual and will therefore be of especial value for practical use.

In many instances the author has recognized that valuation is still in a developmental stage; and after discussing a given subject from one point of view he indicates the other points of view that may be held, without a definite statement of the view that he believes to be correct, thus making his treatment of some subjects suggestive to those who have made a study of valuation problems rather than a guide to the novice.

One chapter sets forth the "Fundamental Principles Which Control When Appraisals of Public-Service Properties Are To Serve as a Basis for Fixing Rates." Some of the principles expressed are those generally accepted, but others relate to matters about which there is still controversy. One of these fundamentals that is eminently sound and yet has often been disregarded is that "a procedure which may be correct if consistently and continuously applied, may be unfair to either the owner or the rate-payer, if introduced at a later period."

Attention is called in the preface to certain features that have been given special consideration or are of a novel type and not to be found elsewhere. One of these is the "non-agreement of the actual life of articles which have a limited period of usefulness with their probable or normal life." The discussion of this subject is said to show the "great advantage in adopting, instead of 'present value,' a rate-base without deduction of depreciation," and this in turn leads to the recommendation of "the method of procedure which he (the author) has named the Unlimited Life Method."

In regard to the non-agreement of the actual with the normal life of articles of property, it may be questioned whether it has more than academic value "as a factor affecting the required earnings." To take account of this non-agreement introduces complications in a matter that is necessarily an approximation on account of the uncertainty of the length of life of the articles that make up a public utility, especially when such length of life is largely dependent upon inadequacy and obsolescence. It also is a feature of limited importance at the present time, in view of the lack of agreement on the broader question as to how the annual sum to be earned for depreciation should be computed, even if the life of the various articles were accurately known.

The author suggests that when a variation of actual from normal life of articles is disregarded "the anomaly results of having to carry in the accounts a part of the cost of articles no longer in use but still in the process of amortization and also of having wiped out the entire cost of others still in service."

The more important of these anomalies is avoided under systems of accounts prescribed by the Interstate Commerce Commission and by other public-service bodies, which provide that depreciation charges with respect to any article shall cease when its cost has been equaled, and that if an article is retired before the depreciation charges equal its cost the balance shall be charged at the time of retirement.

In regard to the "great advantage in adopting, instead of 'present value,' a rate-base without deduction of depreciation," the author recognizes that, under certain methods of depreciation accounting which return annually to the owner of property a part of the money invested in individualized articles, there should be a deduction for the depreciation of such articles when determining a rate-base. He therefore recommends what he has termed the Unlimited Life Method, which will not require the deduction of depreciation. This method is not referred to in the chapter of definitions, but it is variously defined in different parts of the book. The author says (page 184): "The Unlimited Life Method is the most flexible. It may be so applied as to give identical results with the Equal Annual Payment and Sinking Fund Method, or it may be applied to vary somewhat therefrom so as to make the earnings requirements least in the early years."

The principal definition of the method (page 166) is substantially as follows: A method in which no part of the investment need be returned to the owner, except as he is allowed to recover in the earnings the cost of each article as replaced. Under this definition the Unlimited Life Method is what is more generally known as the Replacement Method.

The trend of the times is not toward a method which excludes from the earnings sums sufficient to cover the depreciation of the various plant units as it accrues, but rather toward the inclusion of such sums, thus according with the view laid down by the United States Supreme Court in the Knoxville decision, that the owner of a public utility is entitled to sufficient earnings to keep the investment intact. This view accords also with the sys-

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tem of accounts prescribed by the Interstate Commerce Commission for large telephone companies, and is in increasing accordance with the rules prescribed from time to time by the same commission for the accounting systems for steam roads. Many would think it a step backward to adopt a method that did not conform to these sound financial ideas.

Cash earnings to cover accrued depreciation, even though the amount be somewhat approximate, furnish a better asset for the owner of a public utility than an implied obligation of the public to pay at some future period, which may be repudiated by the public of that period or may become illegal.

The amortization and depreciation tables at the end of the volume are extended and valuable.

While, as indicated above, the book in some of its main features seems not to make recommendations along practical and progressive lines, it is the result of personal contact, long experience and much study of the valuation problem, has been written with much care and contains many valuable ideas, so that it should have a place in the library of all those interested in valuation.

The Revival of Natural Philosophy

GENERAL PHYSICS: An Elementary Treatise on Natural Philosophy—By William S. Franklin and Barry MacNutt. New York: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. viii + 604; 479 illustrations. $2.75 net.

The subtitle of this book is the key to the contents. It is intentionally a somewhat dilute philosophical discussion of those natural phenomena whose study we commonly include under "physics." In recent years it has come to be realized that students of the "natural philosophy" of 70 years ago had proportionately a better grasp of physics, so far as the science had then been developed, than have the students of today in their understanding of modern physics. This realization has brought an insistent demand to return to the methods of Comstock and the other old teachers of natural philosophy—methods which involved only the explanation of laws by every use of homely, practical, everyday, close-to-life occurrences, but methods which had been forced into the discard by the school of pedants who secured almost nation-wide control of physics teaching. The authors of this text have long been known among the leaders in the reform, and the present book is a continuation of their efforts.

The book runs the whole gamut of classical physics, covering mechanics, dynamics, hydraulics, heat, electricity, magnetism, light and sound. There is nothing particularly strange encountered, except in the discussions on thermodynamics, where great attention is paid to entropy. The authors lead up to these topics by a discussion of degenerative processes in general and finally narrow down to thermodynamic degeneration. They endeavor to show that entropy is a measurable property of a substance and that the different values of such measured property, before and after a thermodynamic degeneration, measure the sweeping process. The authors' approach is very acceptable indeed to people who have a considerable knowledge of physics and an inherent and sustained interest in the science, but it will be an extremely difficult, if not an impossible, task to try to make young students absorb this line of reasoning. It would seem that the first approach of students to these very abstract concepts might better be made by going through some of those channels that allow a distinct mental picture to be drawn of what this peculiar thing, entropy, is. All these pictures are known to be faulty; but so far as they go, they furnish an easier approach. The inadequacies and inconsistencies of them can be later eliminated, as the student is more capable of approaching such a presentation as here given.

City Government and Activities

THE AMERICAN CITY: An Outline of Its Development and Functions—By Henry C. Wright, First Deputy Commissioner, Department of Public Charities, New York City. [The National Social Science Series.] New York: A. C. McClurg & Co. Cloth; 4x7 in.; pp. 178. 50c. net.

A birdseye view of the modern city—its government, finances, various activities and its reaction for good or ill on its inhabitants—is presented for the information and stimulus of the general reader. The spirit of the book is admirable, and on the whole the information seems to be reliable; but at some points the author has relied on old data, drawn wrong conclusions or expressed himself obscurely. Probably these slips will do but little harm among the class of readers for whom the book is intended.

New Edition of Slocum's Hydraulics

ELEMENTS OF HYDRAULICS—By S. E. Slocum, B. E., Ph.D., Professor of Applied Mathematics in the University of Cincinnati. New York: McGraw-Hill Book Co., Inc. Second edition, revised and enlarged. Cloth; 6 x 9 in.; pp. xvi + 329; 221 illustrations. $2.50 net.

The appearance of Professor Slocum's second edition in a few months after the appearance of the first edition seems to indicate the success of his idea, which, as pointed out in the review in *Engineering News*, Sept. 16, 1915, was to break away from academic presentations of pure theory in order to secure the interest of the student and to visualize the abstractions that once were too exclusively dealt with.

In its general structure and main details the book remains much as it was before. The effect of practicality has been heightened by dropping the academic terms "hydrostatics," "hydrokinetics" and "hydrodynamics." In place of these are the eminently sensible designations "pressure of water," "flow of water" and "energy of flow." The text is greatly improved and strengthened by inserting a discussion on the use of exponential formulas for flow of water. There are additions on strength of pipe, flow over weirs, siphons, water hammer, and surge-tank problems.

Symposium on Industrial Unrest

LABOR DISPUTES AND PUBLIC SERVICE CORPORATIONS: Proceedings of Academy of Political Science in the City of New York—New York: Columbia University. Vol. VII, No. 1 (January, 1917). Paper; 6x10 in.; pp. iv + 189. $1.50, paper; $2, cloth.

A collection of 15 articles by 20 men, bearing upon the increasing industrial unrest and upon mediation and compulsory arbitration, is included in this volume. The book is divided into four sections: (1) "Government Mediation and Arbitration," (2) "Trade Unions and Compulsory Arbitration," (3) "Trade Unions and Mediation and Conciliation," (4) "Recent Aspects of Labor Disputes." The fourth section discusses arbitration of recent labor disputes and also the Adamson Act, from the employees', employers' and public viewpoints. Touching upon the Adamson eight-hour railway law, Oscar S. Straus states that a representative government is weakest on the eve of an election.

Simple Advanced Electrotechnics

ELECTRICAL ENGINEERING, ADVANCED COURSE — By Ernst Julius Berg, Sc. D., Professor of Electrical Engineering, Union College; author of "Electrical Engineering, First Course." New York: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. viii + 332; 163 illustrations. $3.50 net.

Professor Berg has here prepared a book on the more advanced phases of electrical engineering in a way that a student with only the usual mathematical training can grasp. It is really the written basis of Professor Berg's lectures at Union College, covering transient phenomena, electrostatics, radiation, etc. These are fields which have been adequately presented now for several years by such authors as Steinmetz, Heaviside, Maxwell, Hertz, Fleming, Kelvin, Gray, Bedell and a host of others, but the earlier books have been available only to those of considerable mathematical knowledge.

Naval Architect's Handbook

NAVAL ARCHITECT'S AND SHIPBUILDER'S POCKET-BOOK of Formulas, Rules and Tables and Marine Engineer's and Surveyor's Handy Book of Reference—By Clement Mackrow, late Member of the Institution of Naval Architects, late Lecturer on Naval Architecture at the Bow and Bromley Institute, and Lloyd Woollard, Royal Corps of Naval Constructors, Member of the Institution of Naval Architects, Instructor in Naval Architecture at the R. N. College, Greenwich. New York: Norman W. Henley Publishing Co. Eleventh edition, thoroughly revised, with a section on aëronautics. Leather; 4x7 in.; pp. xii + 742; 264 illustrations. $5.

This is the eleventh edition of a British book containing sections on tabloid mathematics, weights and measures, moments of figures, mechanics, hull design, propellers, powering, properties of shipbuilding materials, admiralty tests, projectiles and armor, ship-service equipment, Lloyd's requirements and Board of Trade requirements. A feature of this edition is a new section on aëronautics.

Field Astronomy for Surveyors

A MANUAL OF FIELD ASTRONOMY—By Andrew H. Holt, Instructor in Civil Engineering in the College of Applied Science of the State University of Iowa. New York: John Wiley & Sons, Inc. Leather; ' x 7 in.; pp. x + 128; illustrated. $1.25 net.

The purpose of this new work on field astronomy is to furnish a text sufficiently concise to fit into a college course in surveying and yet give enough of the fundamentals to enable its use in general practice—a combination which the author thinks has not been accomplished hitherto.

Without attempting to pass on the correctness of the author's contention, there is every evidence that his little book does fill the bill. It is clearly and concisely written and much more complete than the usual college-student manual.

The Electric Telephone

PRINCIPLES OF THE TELEPHONE: Part I, Subscriber's Apparatus—Prepared in the Extension Division of the University of Wisconsin by Cyril M. Jansky, B.S., B.A., Associate Professor of Electrical Engineering, and Daniel C. Faber, E. E., Assistant Professor of Electrical Engineering, University of Wisconsin. New York: McGraw-Hill Book Co. [Industrial Education Series.] Cloth; 6x9 in.; pp. xiii × 160; 125 illustrations. $1.50 net.

This book forms another addition to the industrial-instruction texts issued for the University of Wisconsin's extension work, and it conforms both in readableness and technical content to the high standards set by previous volumes. The parts relating strictly and only to telephone work would make a much smaller book, but to secure the completeness needed in the use intended there are scattered through the pages elementary theoretic explanations of electrical circuits in general.

Only the subscribers' end of the line is described— receivers, transmitters, arresters, switches, bells, co densers, assembed sets, instrument wiring, house wirin etc. The book covers local-battery, common-battery an intercommunicating systems, and both Bell (Weste Electric Co.) and independent equipment.

Practical Arithmetic for Engineers

ARITHMETIC FOR ENGINEERS: Including Simple Algebra Mensuration, Logarithms, Graphs and the Slide-Rule—By Charles B. Clapham, Lecturer in Engineering and Elementary Mathematics at the University of London, Goldsmiths' College. New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. xi + 436; 149 illustrations. $3 net.

The many works appearing on practical mathematics for engineering students would seem to indicate that this is not a subject easily covered. The present book, in common with the others referred to, is intended to be directly useful, all purely academic operations, such as highest common factor and recurring decimals, being omitted. Numerous examples (with answers) are presented that should interest men in the drafting room, machine shop and laboratory as well as those studying for engineering pursuits. A chapter on the slide-rule promises to be helpful to the novice. Other chapters deal with logarithms and graphs.

Elements of British Leveling

LECTURES ON LEVELING: A Practical Course of Instruction Adapted for the Use of Engineering and Survey Students, Planters, Miners and Others in the East—By V. J. Martin, Assoc. M. Inst. C. E., of the Public Works Department, Federated Malay States. Singapore, Straits Settlements: Kelly & Walsh, Ltd. Cloth; 6 x 9 in.; pp. iv + 131; illustrated.

Most of the interest in this book to American readers lies in its curiosities. It is a very elementary and particular account of English practice and instruments of leveling. The chapter on "Some Simple Leveling Instruments and Appliances" contains descriptions of instruments as simple as "boning rods" and is of interest in showing how rough-and-ready results may be accomplished with a little ingenuity and no other appliances than can be made on the job.

The work is worth a place in a collector's library, but would hardly be used as a textbook where American practice prevails.

What Are Mining Stocks Worth?

ENGINEERING ANALYSIS OF A MINING SHARE—By J. C. Pickering. New York: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. viii + 95. $1.50 net.

The considerations entering into the analysis of a mining venture have been instructively set forth by Mr. Pickering. There is little doubt that the great mass of "investors" in mining stocks do not analyze their purchases very sharply. Mr. Pickering, for the sake of simplicity, applies his analysis to a single share, stating that obviously the analysis by shares is equivalent to the analysis of the whole property. He endeavors to follow a line of investigation based on data available to the average shareholder. The discussion is confined to gold, copper, silver, lead and zinc. Of special worth is the chapter that deals with the determination of the value of a mine or mining share. Following this is a chapter on mining versus industrial and other investments, which should be of very general interest.

Sabin on Paints and Varnishes

THE INDUSTRIAL AND ARTISTIC TECHNOLOGY OF PAINT AND VARNISH—By Alvah Horton Sabin, M.S., M. Am. Soc. M. E. New York: John Wiley & Sons, Inc. Second edition, thoroughly revised. Cloth; 6 x 9 in.; pp. x + 473; illustrated. $3.50.

The man who reads for entertainment as well as instruction will appreciate this book. It is a technical work in the true sense of the word; but it is written with the rare style of a classical scholar, and humor is not lacking. It is labeled a second edition, but it is virtually a new book—due to the development of the art and the changed affiliations of the author—he is now a paint and not a varnish man. This second edition is a great deal better than the first one for the peculiar reason that, not being any longer a varnish man, the author feels free to speak more openly of the varnish business and, now being a paint man, he knows more about the paint business than before.

The book opens with a section of definitions and brief fundamental descriptions, such as how varnish is made; what linoxyn is; what pigments and paints are. This is followed by a discussion of the history of paints and varnishes, introducing the original quotations, Greek and Latin, about the earliest processes.

The author leads up to the technology of varnish by a discussion of linseed oil; after finishing with varnish, he runs off into japans, driers, rosin, shellac and the other spirit varnishes, cellulose and celluloid coatings, etc. There is after this a most informing section on paint. It discusses and describes mechanical and chemical properties of the better-known pigments. It outlines the distinguishing features of their employment in oils, varnishes and japans. What may be termed the manufacturing, the paint man's side of the book ends with some notes on Chinese and Japanese lacquers, discussing both manufacture and application.

The rest of the book is devoted essentially to the engineering application of paints and varnishes and materials intended to serve the same purpose of protection or ornamentation. This engineering section is arranged under two heads—(1) protection of metals against corrosion, and (2) house and carriage painting and furniture varnishing.

The notes on protection of metals open with a discussion of the performance of concrete coatings and of concrete over paint, and go into the cleaning of steels and the actions of the various coatings. The technique of application is discussed from the paint makers' viewpoint. There are text and tabulated results of innumerable tests. Special chapters on pipe coatings and ship-bottom paints are built up in much the same general way.

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Forestry for Young America

THE BOOK OF FORESTRY—By Frederick Franklin Moon, M.F., Professor of Forest Engineering, New York State College of Forestry at Syracuse. New York: D. Appleton & Co. Cloth; 5x8 in.; pp. xvii + 315; 64 illustrations. $2.

The principles and practices of forestry with attention to the conservation and use of natural resources are simply and entertainingly outlined in this volume. Although designed more particularly for youthful readers the book is suitable for persons of any age who wish to get a general view of forestry. Part I deals with forest growth, management and utilization and Part II contains text and cuts designed to aid in the identification of growing trees and of wood that has been cut.

The Railroads' Plan for Improving the Railroad Situation

GOVERNMENT PARTNERSHIP IN RAILROADS—By Mark Wymond. Chicago: Wymond & Clark. Cloth; 6 x 9 in.; pp. 178. $1.50.

Mr. Wymond is a good spokesman for the railroads, assuming, what seems to be true, that he represents them with his solution of the troublesome plan of railway regulation—much in the same unofficial way that he represented them with his earlier book, "Railroad Valuation and Rates" (reviewed in *Engineering News*, July 20, 1916). Mr. Wymond's candid and quiet statements will gain a wider hearing, in spite of his obvious leanings, than the once familiar broadside loaded with bombast and exaggeration.

His argument is that regulation of extensive systems by state commissions is patchwork, while good results dictate a single Federal commission. On account of the great burdens of the existing Interstate Commerce Commission, he would reorganize it into a directing body placed over eight district commissions on which there would be specific representation of agricultural and industrial shippers, railway labor and railway administration. He would have the Government guarantee the interest on railroad investment and have the surplus above a fair return divided some way between the roads and the public. He would permit pooling traffic to reduce the cost of service and the need of extensions.

Mr. Wymond finally turns his attention to Government ownership, intimating that it is the alternative of complete Federal control. He cites experience elsewhere and advances the opinions that the motives causing it in other countries are lacking here, that it will increase rates, that it will introduce politics into industry, that it will introduce a fatal experimental period, that states will lose millions in tax revenue, that it will allow shippers no redress for losses and that various other dire results will be seen.

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American Biography Continued

THE NATIONAL CYCLOPÆDIA OF AMERICAN BIOGRAPHY. Edited by Distinguished Biographers. New York: James T. White & Co. Vol. XV. Cloth; 8 x 11 in.; pp. 416; 700 illustrations. $10.

Biographical sketches of engineers to the number of forty odd are included in this fifteenth volume of American biography. The subjects of these sketches include such men as Spencer Miller, Ralph Modjeski, George W. Kittredge, Onward Bates and some others of national reputation, and some of much less renown.

In general, the sketches are interesting and give the essential facts in the engineering careers of these men. Unfortunately some of the sketches of living men are written with such an overload of fulsome praise as to be in rather bad taste in a volume designed for the use of future generations as well as for contemporaries.

The fifteen volumes of the National Cyclopædia of American Biography now contain biographical sketches of several hundred engineers and inventors and are so thoroughly indexed as to furnish an important work on engineering and industrial history. It is increasingly evident that engineers are playing and will continue to play one of the most important rôles in current history, and any conscientious effort to compile and publish data of historical value in regard to their lives and works is surely to be commended.

Guide to Export Trade

EXPORT TRADE DIRECTORY, 1917-18: Export Merchants, Manufacturers' Export Agents, Foreign-Exchange Bankers, Foreign-Freight Forwarders, Steamship Lines, Foreign Consuls, etc., in Principal Ports of the United States —Compiled under the supervision of B. Olney Hough, Editor, "American Exporter." New York: Johnston Export Publishing Co. Fifth edition. Cloth; 6x9 in.; pp. 536. $5.

The new edition of the "Export Trade Directory" lists 1562 American export houses, of which 1295 are in New York City. The term "export merchant" in this book refers both to merchants who buy on their own initiative and risk and export commission houses which buy only those specific goods and quantities that foreign importers instruct them to buy. Also under this heading are included the buying offices in the United States of foreign merchants, mining and railway companies and industrial establishments of all sorts whose headquarters or business interests are in other countries. The book is divided into 12 parts and a general index of names. Part 3 is a list of leading bankers engaged in foreign-exchange business. Then there are lists of marine-insurance companies in New York City, of foreign-freight forwarders, and of steamship services to foreign ports.

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With the new year the New Jersey State League of Municipalities began the publication of a bulletin entitled "New Jersey Municipalities" (address Claude H. Anderson, director of Bureau of Municipal Information, Princeton University Library, Princeton, N. J.).

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Under the chairmanship of Arthur N. Pierson, a member of the assembly, or lower branch, of the New Jersey Legislature (address State House, Trenton, N. J.), a Commission for the Survey of Municipal Financing submitted a half-dozen bills to the New Jersey Legislature of 1916, providing for some thorough-going reforms in the control of municipal bonds and municipal financing generally. One of these bills, limiting the life of municipal bonds to that of the improvement they are to pay for and containing other admirable regulative features, became a law in 1916; but the other bills were vetoed by the governor, although passed by the legislature. The commission was continued. The report before us gives the further ideas of the commission regarding a thorough-going system of budget control or a definite yearly program of municipal expenditures correlated with receipts; and also regarding the administration, regulation and supervision of sinking funds.

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A new topographic map of Washington, D. C., and vicinity has just been issued by the United States Geological Survey. It is the result of recently completed fieldwork and represents as high accuracy and refinement as can be attained in a map printed on the scale used. It shows an area of 465 sq.mi., which includes almost every form of topography, from the lowlands along the Potomac Drive to the broken country in Rock Creek Park and the picturesque gorge of the Potomac above the city. Black is used for artificial features, such as railroads, roads and houses; blue for streams and water surfaces; and brown is used for the 10-ft. contours. An automobile edition shows routes of all-the-year-round good roads in bright red and connecting links in dotted red lines. The scale used is 2 in. to the mile, or 1 to 31,680. The map measures 44x53 in. Its price is 25c. retail, or 15c. each in lots of 50 or more. (Washington, D. C., Director, United States Geological Survey.)

NEW PUBLICATIONS

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known to the editor, the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be secured without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other person indicated in the notice.]

ADMINISTRATIVE REPORT AND ECONOMIC AND GEOLOGICAL PAPERS: Year Book for 1915—Work in coöperation with United States Geological Survey, State Geological Survey, and University of Illinois. Urbana, Ill.: State Geological Survey. Bulletin No. 33. Cloth; 7 x 10 in.; pp. 180; illustrated.

BETTER CITY PLANNING FOR BRIDGEPORT: Some Fundamental Proposals to the City Plan Commission—By John Nolen, Consultant on City Planning, with a Report on Legal Methods of Carrying out the Changes Proposed in the City Plan by Frank Backus Williams, of the New York Bar. Bridgeport, Conn.: The Commission. Paper; 9 x 12 in.; pp. xx + 159; illustrated.

Mr. Nolen here makes a final report, following his preliminary report of 1915. Main lines of communication, centers and proposed street changes in the downtown district, block and lot subdivisions, districting, parks and playgrounds are the chief subjects considered.

BLAST-FURNACE CONSTRUCTION IN AMERICA—By J. E. Johnson, Jr. New York: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. xi + 415; 247 illustrations. $4.

THE BULLETIN OF THE AFFILIATED ENGINEERING SOCIETIES OF MINNESOTA—Annual Edition, Vol. I, 1916. St. Paul, Minn.: Civil Engineers' Society of St. Paul, Minnesota Surveyors' and Engineers' Society. Paper; 6 x 9 in.; pp. 217; illustrated. 50c.

CALIFORNIA WATER PROBLEMS—Report of conference held Nov. 25, 1916, under instructions of the California Legislature to recommend "a unified state policy with reference to irrigation, reclamation, water storage, flood control, municipalities and drainage, with due regard to the needs of water power, mining and navigation." Sacramento, Calif.: [State Water Commission.] Paper; 6 x 9 in.; pp. 125.

CARPENTRY—By Ira Samuel Griffith, Chairman of the Manual Arts Department, University of Missouri. Peoria, Ill.: The Manual Arts Press. Cloth; 5 x 8 in.; pp. 188; 152 illustrations. $1.

THE CITY MANAGER AND CITY ENGINEER-MANAGER Plans of Municipal Government—By Kenyon Riddle, Municipal Engineer. Abilene, Kan. Paper; 6 x 9 in.; pp. 31.

CITY MILK SUPPLY—By Horatio Newton Parker, Member, International Association of Dairy and Milk Inspectors. New York: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. xi + 493; 63 illustrations. $5.

CITY PLANNING—By Frank G. Bates, Associate Professor of Political Science, Indiana University. Indianapolis, Ind.: Indiana Bureau of Legislative Information. Bulletin No. 8, December, 1916. Paper; 5 x 7 in.; pp. 31.

COBALT ALLOYS WITH NON-CORROSIVE PROPERTIES—By Herbert T. Kalmus, B. Sc., Ph. D., and K. B. Blake, B. Sc. Ottawa, Ont.: Department of Mines. Paper; 6 x 9 in.; pp. 51; illustrated.

A COMPARATIVE BACTERIOLOGICAL STUDY OF THE WATER-SUPPLY OF THE CITY AND COUNTY OF DENVER, COLORADO, February, 1917—By Walter G. Sackett. Fort Collins, Colo.: Experiment Station, Colorado Agricultural College. Bulletin 225. Paper; 6 x 9 in.; pp. 14; illustrated.

COST KEEPING AND CONSTRUCTION ACCOUNTING: Adapted to Any Work Consisting of Numerous Items, Departments or Divisions on Which Detailed Unit Costs Are Desired—By G. Ed Ross, Auditor, State Highway Department. Salem, Ore.: The Author. Cloth; 5 x 8 in.; pp. xiv + 59; illustrated.

THE DESIGN OF RAILWAY LOCATION: A Study of the Physical and Economic Conditions That Control the Location of Railways in Order That Their Operation May Be at Maximum Safety and Efficiency—By Clement C. Williams, Assoc. M. Am. Soc. C. E. New York: John Wiley & Sons, Inc. Cloth; 6 x 9 in.; pp. vii + 517; 106 illustrations. $3.50 net.

ELECTRICAL EQUIPMENT, ITS SELECTION AND ARRANGEMENT, with Reference to Factories, Shops and Industrial Plants—By Harold W. Brown, B. S., M. M. E., Department of Electrical Engineering, Cornell University. New York: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. xiii + 229; 109 illustrations. $2 net.

ENGINEERING OFFICE SYSTEMS AND METHODS, Together with Schedules and Instructions for the Collection of Preliminary Data for Engineering Projects; Sampling, Inspecting and Testing Engineering Materials; Conducting Domestic and Export Shipping Operations, etc.—By John P. Davies, Assoc. M. Am. Soc. C. E. New York: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. xvi + 544; 244 illustrations. $5 net.

This volume, which has gone to second printing with corrections, was reviewed in our issue of May 20, 1915.

FAILURE OF BRASS: 1. Microstructure and Initial Stresses in Wrought Brasses of the Type 60% Copper and 40% Zinc—By Paul D. Merica, Associate Physicist, and R. W.

Woodward, Laboratory Assistant, Bureau of Standards. Washington, D. C.: Bureau of Standards. [Technologic Paper No. 82.] Paper; 7 x 10 in.; pp. 72; 120 illustrations. 20c. a copy from Superintendent of Documents.

FLUSHING: Its Place in the Street-Cleaning Field—By Raymond W. Parlin, Engineer with the New York Bureau of Municipal Research. Newark, N. J.: American Society of Municipal Improvements. Paper; 6 x 9 in.; pp. 29; 22 illustrations.

Probably this is the most complete collection of cost data on street flushing available. It includes an investigation of this method of street cleaning in several cities, and the analyses of cost are carried out in great detail.

GAS CHEMISTS' HANDBOOK—Compiled by Technical Committee Subcommittee on Chemical Tests, 1916, A. F. Kunberger, Editor. New York: The American Gas Institute. Cloth; 6 x 9 in.; pp. 354; 73 illustrations. $3.50 postpaid in the United States and Canada.

HIGH FREQUENCY APPARATUS: Its Construction and Practical Application—Thomas Stanley Curtis, Editor. New York: Everyday Mechanics Co., Inc. Cloth; 5 x 7 in.; pp. xvi + 243; illustrated. $2.

HIGHWAYS AND WATER RESOURCES OF OREGON: Report for Two Years Ended Nov. 30, 1916, of John H. Lewis, State Engineer, Salem, Ore.—Paper; 6 x 9 in.; pp. 165; illustrated.

THE HOMESTEAD COMMISSION: Annual Report, 1916—Boston: The Commission. [No. 103.] Paper; 6 x 9 in.; pp. 79; illustrated.

HOW TEXAS MUNICIPALITIES CAN SOLVE THEIR SEWAGE DISPOSAL PROBLEMS—By Charles Saville, Director of Public Health, Dallas, Tex. Reprint of an address before the League of Texas Municipalities. Paper; 6 x 9 in.; pp. 13.

HYDROMETRIC SURVEYS: Report of Stream Measurements, 1915—Prepared under the direction of F. H. Peters, C. E., Commissioner of Irrigation, by R. P. Sauder, C. E., Chief Hydrometric Engineer, assisted by G. H. Whyte and N. M. Sutherland, Divisional Hydrometric Engineers. Ottawa, Canada: Department of the Interior. Paper; 7 x 10 in.; pp. v + 590; illustrated. 35c.

INDUSTRIAL COMMISSION: Annual Report for year ended Sept. 30, 1915—Albany, N. Y.: Department of Labor. [No. 56.] Cloth; 6 x 9 in.; pp. 417.

INSTRUCTIONS TO LOCATING ENGINEERS AND FIELD PARTIES—By F. Lavis, M. Am. Soc. C. E. Reproduced in abridged form from "Railroad Location Surveys and Estimates." New York: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 44; illustrated. $1 net.

INVESTIGATIONS OF GRAVEL FOR ROAD SURFACING: Official Publication of Iowa State College of Agriculture and Mechanic Arts, Dec. 10, 1916—By T. R. Agg, Highway Engineer. Ames, Iowa: Engineering Experiment Station. Bulletin 45. Paper; 6 x 9 in.; pp. 32; illustrated.

LETTERING FOR DRAFTSMEN, ENGINEERS AND STUDENTS; A Practical System of Freehand Lettering for Working Drawings—By Charles W. Reinhardt (former Chief Draftsman, "Engineering News"). Fourteenth Edition, Revised and Enlarged. New York: D. Van Nostrand Co. Boards; 8 x 11 in.; pp. 39; 15 plates. $1 net.

A LOGARITHMIC STADIA REDUCTION TABLE—By Francis S. Foote, Jr. Berkeley, Calif.: University of California Press. Vol. I, No. 11. Paper; 7 x 11 in.; pp. 281-292.

MANUFACTURE OF ARTILLERY AMMUNITION—By Members of the Editorial Staff of the "American Machinist": L. P. Alford, Editor in Chief; F. H. Colvin, E. A. Suverkrop, Robert Mawson, John H. Van Deventer. New York: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. xii + 765; 669 illustrations. $6 net.

MICHIGAN STATE HIGHWAY COMMISSIONER—Report for Two Fiscal Years Ended June 30, 1916—Lansing, Mich.: Frank F. Rogers, State Highway Commissioner. Paper; 6 x 9 in.; pp. 140; illustrated.

MICROSCOPIC EXAMINATION OF STEEL—By Henry Fay, Ph. D., D. Sc., Professor of Analytical Chemistry, Massachusetts Institute of Technology; Consulting Metallurgist, Watertown Arsenal. First edition. New York: John Wiley & Sons, Inc. Cloth; 6 x 9 in.; pp. 18; 56 illustrations. $1.25 net.

THE NATURAL PURIFICATION OF WATER BY FREEZING—By H. A. Whittaker, Director, Division of Sanitation. St. Paul: Minnesota State Board of Health. Paper; 6 x 9 in.; pp. 3.

On conditions governing safety of ice supplies; with five conclusions.

NEW JERSEY MUNICIPAL STATUTES: Report of the Commission To Revise and Codify the Statutes Relating to Cities and Other Municipalities. Trenton: The Secretary of State. Paper: 6 x 9 in.; pp. 354.

OIL INVESTIGATIONS IN ILLINOIS IN 1916—Under direction of Fred H. Kay. Work in coöperation with United States Geological Survey, State Geological Survey, and University of Illinois. Urbana, Ill.: State Geological Survey. Bulletin No. 35. Paper; 7 x 10 in.; pp. 80; illustrated.

PROCEEDINGS AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION, INC.: Report of Annual Convention, 1916—Atlantic City, N. J.: The Society. Cloth; 6 x 9 in.; pp. xlviii + 846; illustrated.

PROCEEDINGS MASTER CAR BUILDERS' ASSOCIATION: Report of Annual Convention, 1916—Atlantic City, N. J.: The Society. In two parts. Cloth; 6 x 9 in.; pp. xlvii + 1168; illustrated.

PROCEEDINGS OF THE EIGHTH NATIONAL CONFERENCE ON CITY PLANNING, Cleveland, 1916—New York: Nelson P. Lewis, Vice-Chairman. Cloth; 6 x 9 in.; pp. vi + 275.

PROPOSED SPECIFICATIONS FOR FIRE HOSE AND REPORT THEREON, January, 1917—Rochester: Bureau of Municipal Research, Inc. Paper; 6 x 9 in.; pp. 23.

Drawn by the bureau named, to meet the claim of a representative of a fire-hose manufacturer, who urged that the old specifications were closed ones, which precluded more than one manufacturer from bidding. The specifications were adopted by the Board of Contract and Supply, since which it appears that competition has been secured.

PUBLIC ENGINEERING AND HUMAN PROGRESS—By Morris Llewellyn Cooke, Consulting Engineer, Philadelphia. Presented before the Cleveland Engineering Society, Nov. 14, 1916. Paper; 6 x 9 in.; pp. 15.

PUBLIC SERVICE COMMISSION, SECOND DISTRICT, NEW YORK: Abstracts of Reports of Corporations, 1915—Albany, N. Y.: Public Service Commission. Cloth; 9 x 12 in.; pp. vii + 304; illustrated.

QUARRY ACCIDENTS IN THE UNITED STATES During 1915—Compiled by Albert H. Fay. Washington, D. C.: Bureau of Mines. [Technical Paper 165.] Paper; 6 x 9 in.; pp. 77. 10c. from Superintendent of Documents.

RIVETED BOILER JOINTS: A Treatise on the Design and Failures of Riveted Boiler Joints, with Numerous Original Diagrams Enabling the Designer To Design any Desired Joint Without Calculations—By S. F. Jeter, Member of Boiler Code Committee, Am. Soc. M. E. New York: McGraw-Hill Book Co., Inc. Cloth; 11 x 8 in.; pp. ix + 155; 52 illustrations. $3 net.

SEWAGE DISPOSAL FOR VILLAGE AND RURAL HOMES: Official Bulletin of Iowa State College of Agriculture and Mechanic Arts, Aug. 10, 1916—By C. S. Nichols. Ames, Iowa: Engineering Experiment Station. Bulletin 41. Paper; 6 x 9 in.; pp. 31; illustrated.

SEWAGE TREATMENT BY AERATION AND ACTIVATION—By George T. Hammond, Engineer of Design and in Charge of the Sewage Experiment Station, Bureau of Sewers, Brooklyn, N. Y. Reprinted from the "Proceedings" of the American Society of Municipal Improvements, 1916. Paper; 6 x 9 in.; pp. 101; illustrated.

A comprehensive review of this promising new method of sewage treatment, based on personal investigation at many of the large-scale experimental plants and correspondence with those in charge of other plants.

SPECIAL COMMITTEE ON PUBLIC UTILITIES: Report of General Assembly of Illinois, Together with a Draft of a Bill To Provide Local Control of Public Utilities in Chicago, Jan. 20, 1917—Chicago, Ill.: The Commission. Paper; 6 x 9 in.; pp. 29.

SPRAY IRRIGATION—By Milo B. Williams, Irrigation Engineer. Washington, D. C.: United States Department of Agriculture. Bulletin No. 495. Paper; 6 x 9 in.; pp. 40; 19 illustrations. 10c. a copy from Superintendent of Documents.

THE STABILITY OF ARCHES—By Ernest H. Sprague, A. M. Inst. C. E. London: Scott, Greenwood & Son. New York: D. Van Nostrand Co. [The Broadway Series of Engineering Handbooks. Vol. XX.] Cloth; 5 x 8 in.; pp. viii + 141; 58 illustrations. $1.25.

STATISTICS OF COMMON CARRIERS: A Preliminary Abstract for the Year Ended June 30, 1916—Washington, D. C.: Interstate Commerce Commission. Paper; 9 x 12 in.; pp. 237.

STEAM BOILERS, THEIR THEORY AND DESIGN—By H. de B. Parsons, M. Am. Soc. M. E., M. Am. Soc. C. E., Professor Emeritus of Practical Engineering, Rensselaer Polytechnic Institute. Fifth edition. New York and London: Longmans, Green & Co. Cloth; 6 x 9 in.; pp. xvii + 377; 157 illustrations. $4 net.

TOPICOS TECHNICOS—By Ing. Octavio A. Acevedo. Santo Domingo, R. D.: The Author. Paper; 6 x 9 in.; pp. 114.

The book contains nine short papers, in Spanish, including El Mapa de la Republica—Informe Oficial Acueducto de San Pedro de Macoris, and Problemas Capitalenos—Acueducto, Cloacas y Pavimentacion.

TRACÉ SANITAIRE DES VILLES (Technique Sanitaire Urbaine)—By Dr. F. Saturnino Rodrigues. Paris: Imprimerie Chaix. New York: American Trading Co. Paper; 6 x 9 in.; pp. xiv + 128; illustrated. 10 francs.

An essay on city planning, with special reference to hygienic and sanitary conditions and to Brazil.

THE TREND OF LEGISLATION FOR PUBLIC HEALTH—By Arthur Connors. Indianapolis, Ind.: Indiana Bureau of Legislative Information. Bulletin No. 9, December, 1916. Paper; 5 x 7 in.; pp. 38.

UNIFICATION OF LOCAL GOVERNMENTS IN CHICAGO: Report Prepared by the Chicago Bureau of Public Efficiency—Paper; 6 x 9 in.; pp. 98; illustrated.

A sequel to a report by the same bureau in 1913 entitled "The Nineteen Local Governments in Chicago" (now increased to 22). The present report is designed to show the need for more complete unification and to present a simple plan of organization calculated to produce greater efficiency from public officials.

UNIFIED ACCOUNTING METHODS FOR INDUSTRIALS—By Clinton E. Woods. New York: The Ronald Press Co. (20 Vesey St.) Leather and cloth; 6 x 9 in.; pp. xvi + 484; illustrated. $5 postpaid.

WATER-POWERS OF MANITOBA, SASKATCHEWAN AND ALBERTA—By Leo G. Denis, Hydro-Electric Engineer. Ottawa, Ont.: Canada Commission of Conservation. Also additional data respecting Water Powers of Southern Manitoba and Bow River by J. B. Challies, M. Can. Soc. C. E., Superintendent, Water-Power Branch, Department of the Interior. Cloth; 6 x 9 in.; pp. ix + 334; 40 illustrations, maps and diagrams.

WEIGHTS AND MEASURES: Eleventh Annual Conference of Representatives from Various States Held at the Bureau of Standards, Washington, D. C., May, 1916, with appendix giving specifications adopted by the Conference and recommended by the Bureau of Standards for adoption by the several states, and appendix giving paper on Liquid-Measuring Pumps, by F. S. Schlink—Washington, D. C.: Bureau of Standards. Paper; 7 x 10 in.; pp. 153 + 43 + 27. 35c. per copy from Superintendent of Documents.

Notes from Field and Office

Clearing ditches and dressing slopes with crane and grab—Cement gun lines old tunnel—An adding machine in an engineering office—Discussion of errors in ordinary stadia work

Ditching Track with Crane and Grab Bucket

Clearing ditches and dressing the slopes of cuts by means of an "auto-crane" that travels along the tops of the cuts are interesting features of improvement work on the eastern division of the Pennsylvania Lines (Pittsburgh, Penn., to Crestline, Ohio, 188 miles). The railway company has a ditching machine that travels on the main track; but its use interferes with traffic, and work must be interrupted frequently while the machine gets clear of trains. A contract for the work was let to Laidlaw Brothers, of Pittsburgh, who use the equipment noted above and thus work independently of the railway traffic. The accompanying view shows the ditching outfit at work.

DITCHING WITH AUTO-CRANE AND GRAB BUCKET; PENNSYLVANIA LINES

The machine is an auto-crane built by the John F. Byers Co., of Ravenna, Ohio. It has a hoisting engine and boiler on a steel frame that also carries a headframe, mast and boom. The frame is mounted on broad-tired wheels, which travel on the ground or on plank runways. The machine is self-propelling, by means of chain drive to the two wheels at the crane end, and for heavy side lifts it can be braced by an inclined outrigger fitted to the top of the headframe and having a jack attached to its foot. There are two interchangeable booms, 18 ft. and 28 ft. long, and a narrow ½-yd. Owen bucket is used for ditching. The total weight of the outfit (including bucket) is about 12 tons.

The ditching has been completed for about 10 miles, on both sides of the track, and the average excavation is 400 cu.yd. per day. The short and long booms are used for light and deep cuts respectively, and the ditching has been done in cuts as deep as 60 ft. The material is deposited along the top of the cut, but can be loaded for removal if desired.

With the machine are an engineman or runner, a fireman, a helper and a team driver. They have a wagon for hauling coal and a tank wagon for bringing water from the nearest stream. Coal is supplied by the railway, which delivers it in piles ahead of the work. One man works with the bucket to spot it in position; two men with mattocks and shovels and a templet (1 on 1½) follow to trim, or "sandpaper," the slope. There is also a man to level off the spoil bank as the material is dumped from the bucket. A line is stretched to show the track side of the ditch, and the grade is kept by measuring from the rail.

Sometimes the machine works along the foot of the slope, if there is plenty of room; but usually it travels along the top of the cut. In moving from one cut to another it travels ordinarily under its own power. Where the right-of-way is very rough, however, the railway company furnishes a wrecker or derrick car that picks up the machine, swings it over the track and carries it (not loaded on a car) to the new site, depositing it in position to resume operations at once.

The ditching work is under the direction of E. B. Taylor, Jr., Division Engineer, Pennsylvania Lines, and E. G. Johnson, Assistant Engineer, at Pittsburgh, Penn.

Lining an Old Railway Tunnel with Concrete from Cement Gun

The Illinois Central R.R. has near Unionville, Ind., a single-track tunnel 506 ft. long, driven through shaley limestone. This was hard when freshly exposed, but disintegrated on exposure to the air and to moisture. As a result the stone was continually flaking off the sides and roof. Constant watching was necessary, especially as the action would occasionally release a boulder and there was always danger of accident. Estimates were made for a solid concrete lining; but as the tunnel section had grown to considerable proportions, the cost would have been large, while it would have been difficult to do the work without interfering with traffic.

Under the conditions it was decided to use the cement gun to apply a lining that would seal up all cracks and, by excluding air, moisture and locomotive gases, prevent any

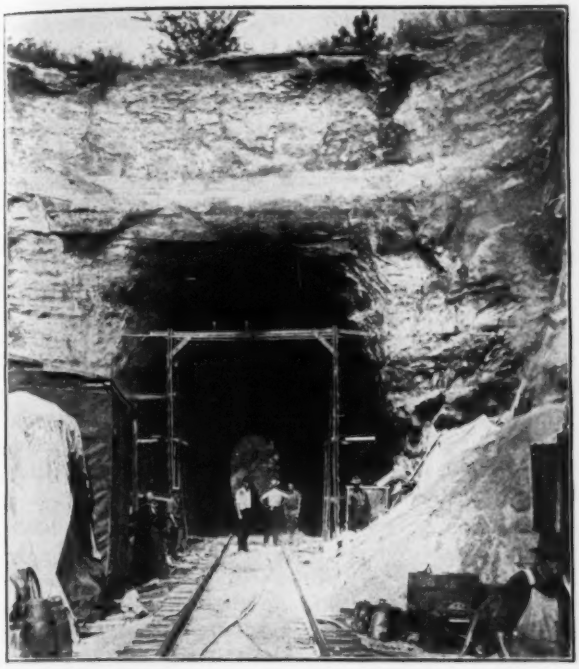

FIG. 1. ERODED ROCK TUNNEL WITH EQUIPMENT IN PLACE FOR LINING

further deterioration of the rock surfaces. The contract was let to the Cement-Gun Construction Co., of Chicago, for the entire work, which was carried out with satisfactory results. Information and photographs have been furnished by that company.

Fig. 1 shows the west end of the tunnel, with equipment (at the right of the portal) in position to start the work. The compressor was a little farther away from the portal, as shown at the right. A light timber gantry was erected for the use of the men at work on the lining. This gave sufficient side and top clearance to offer no obstruction to passing trains and was mounted on six rollers, so that it could be run on a temporary plank track.

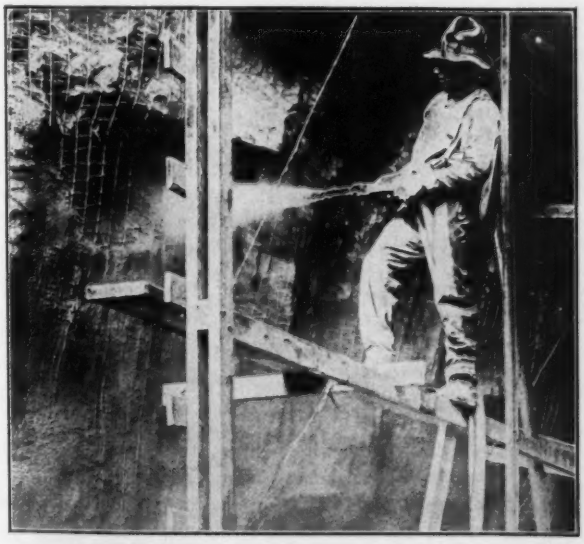

FIG. 2. BLOWING CONCRETE ONTO WIRE NETTING SECURED TO THE FACE OF THE ROCK
The finished surface will be noted at the lower left-hand corner

The interior surface of the tunnel was very irregular, deep cavities alternating with projecting boulders. The average height was 26 ft. and the average width about 22 ft. The surface of the rock was first thoroughly cleaned by chipping off all defective stone and cutting away projecting points. Holes were then drilled, spaced about 30 in. each way, into which track spikes were driven. To these spikes was secured wire mesh, placed so as to follow the contour roughly, without any attempt to get even lines. Through this wire mesh, mortar was shot with the cement gun, as shown in Fig. 2. The lower left-hand corner of the picture shows some of the surface of the work as it appeared when completed. The wire mesh was pressed into the larger cavities and across smaller ones, so that small holes were shot full of gun-crete. After completion of the lining, portals of ordinary poured concrete were built at both ends.

The concrete consisted of a 1:3½ mixture of portland cement and clean sharp sand. This was mixed dry before being placed in the cement gun, water for hydration being added at the nozzle in the usual manner. An air compressor driven by a fuel-oil engine furnished approximately 200 cu.ft. of free air per minute and used about 1 bbl. of fuel oil per 9-hour day. The work was started about Sept. 1 and finished early in October, 1916. There was an average of 10 trains per day through the tunnel, and the entire work was done without interference with the traffic.

Various Uses for Adding Machines in Engineering Offices

By Edwin S. Fuller*

The work of many engineering offices involves so much addition that it becomes necessary to purchase an adding machine. In most such offices the machine is used only for addition and stands idle a large part of the time. The writer has found the adding machine valuable for much work outside of the limited field of straight addition. A few special cases will be described as a suggestion of the possibilities.

The Adding Machine as a Tabulating Typewriter

The Water-Supply Papers, in which the United States Geological Survey publishes the results of its stream-flow investigations, contain among other things tables showing the gage height and discharge of a large number of streams for each day of the year. For convenience in computing and filing, the office forms are arranged with parallel columns for gage height and discharge, but for the published reports separate tables of gage height and of discharge are prepared.

The preparation of the printer's copy of these tables has always been something of a problem. For some years manuscript tables were prepared by making two blueprints from the original double form, crossing out with a colored pencil the discharge figures on one print and the gage-height figures on the other. This resulted in a bulky, shabby-looking manuscript, and there were frequent typographical errors due to poor copy. To improve the copy, it became necessary to make a negative from the original double form and two black-line prints,

*Hydraulic Engineer, Washington, D. C.

crossing out with colored pencil as before. This relieved a part of the eyestrain for the typographer, but did not improve the original long-hand figures nor the looks of the manuscript and resulted in a greatly increased cost.

The writer suggested the use of some form of type-printing machine for the preparation of these tables and was authorized to investigate the matter. Various forms of typewriters were first tried out, but were found not entirely satisfactory. The adding machines already in the office were then tried, and it was found that these tables could be made by anyone familiar with the use of an adding machine in much less time than was required by an expert operator on a tabulating typewriter.

The computation of the data on the double form involved the addition of the daily discharge figures for each month; and this addition was made on the printer's copy instead of on a list as formerly, so that the only work required for the preparation of these two tables consisted of tabulating the daily gage heights on the adding machine, an operation requiring about 10 min. In this way it was possible to prepare neatly typewritten printer's copy at a cost less than one-fourth that of the former unsatisfactory copy, and the new method has now been generally adopted by this organization.

On large irrigation projects, where a record is kept of the amount of water delivered to the water users, the tabulation of these figures involves a large amount of work. By tabulating the ditch-riders' reports on an adding machine the time required may be materially reduced, and more legible tables result. Also, the addition involved in the computation of results may be carried on at the same time the figures are being tabulated, thus saving one complete step.

Use for Multiplying and Dividing

The adaptability of the adding machine to multiplication is not generally realized. By treating any multiplication as a series of additions the exact product of any two numbers may be readily obtained on an adding machine[1]. The capacity of a nine-bank adding machine is as great as that of seven-place logarithms, and even on an eight-key machine a skilled operator can compete successfully with a user of logarithm tables. The construction of the ten-key adding machines is such that they are especially adapted to multiplication, and the use of long-hand multiplication, tables of products, or logarithms, can be entirely eliminated to advantage in offices equipped with such machines.

The process of division can be accomplished on any adding machine to advantage by the use of reciprocals. The intelligent use of significant figures is essential if adding machines are to be used to best advantage in computation. For a very large part of engineering computations not more than four or five significant figures are required in the results, and this makes the adding machine especially adaptable to this class of work.

A complete table of four-place reciprocals from 1 to 1000 may be readily tabulated on the machine itself and posted in front of the operator. In many engineering offices the character of the computations is such that a limited number of reciprocals and constants is used repeatedly. These may be tabulated and posted in front of the operator, but it will be found that they are involuntarily memorized by the computer who soon uses the machine almost automatically.

The work of the Government service above referred to involves the computation of mean monthly values for each of the rating stations for which data are published. These computations have been made with the aid of tables of products and conversion tables, and many of the computers have developed great speed in the use of these tables. The writer has found, however, that these computations may be made more quickly and with less effort on the ten-key adding machine, using a few easily memorized multipliers.

In building appraisal it is customary to compute the cost of buildings on the basis of a unit cost per square foot of floor area or per cubic foot of volume. The computation of floor area or cubic contents of a building involves both multiplication and addition. In the recent building appraisal of Los Angeles County, tables of products were used, these tables giving the area of the rectangles into which the floor areas were divided. It was found that the computations could be made at much greater speed and with much less effort on the adding machines, which had previously been used only for straight addition, and that the extensions involved in applying the unit price and the depreciation factors could be carried out as a step of this computation instead of as a separate step.

Accuracy and Speed

The accuracy attained by adding-machine operators is remarkable. In a top-speed test observed by the writer between computers on two different types of adding machines on a test involving some 5000 multiplications, only three errors were made by the two operators.

The greater use of the adding machine, when adapted to all the work in an office, results immediately in the production of skilled operators whose speed on ordinary addition will be found to have increased materially. The mental strain in operating an adding machine is almost nothing; and where electrically operated machines are used, the physical strain is very slight. It has been the writer's experience that the average clerk or computer will tend to maintain a higher efficiency when working on an adding machine than when doing any other form of office work, and the momentum gained in the increased use of an adding machine invariably results in improving the general tone of the office work.

[1] See "Engineering News," Oct. 7, 1915, p. 703.

Methods and Accuracy of Results of Transit and Stadia Topography

By Cyrus Townsend Brady, Jr.*

For line surveys always, and for other work with inexperienced men, the writer considers the transit and stadia method preferable to any other. It is understood that the resulting map is to be plotted to the usual scales of from 400 up to 1000 ft. to the inch—that is, 1:4800 to 1:12000.

One important advantage comes from only one man being needed besides the rodmen. In many cases (depending on wages, etc.) it is more economical to put two parties in the field, when two surveyors are available, rather than to use them as instrumentman and recorder.

*United States Steel Products Co., Buenos Aires, Argentina, S. A.

Another advantage is the ability to work in unfavorable weather and in woods or tall grass and bushes, where the plane-table is cumbersome to handle or difficult to protect from tearing or wetting of the paper.

The method has two disadvantages: It is not possible to make sure that "holes" have not been left in the topography before plotting the map, and the sketches made in the field and the side shots are often insufficient for accurate drawing. The first objection at least can be met by plotting the principal lines before leaving the field; and by inspection any doubtful areas will be noticed.

This plotting of the lines brings up a great advantage of the method: The traverse is plotted from calculated coördinates; and if closed or controlled by precise points, errors are easily distributed. Work on the plane-table is affected not only by stretching of the paper, but also by natural errors accumulating at the checking points, frequently so large as to require objectionable distortions of the mapping or even a redrawing in the office, in which case the expense is increased.

How To Deal with Errors in Stadia Work

The presence of errors must always be recognized, as stadia traverses are apt to give deceptive appearances of accuracy. On a certain 8000-hectare survey a traverse 45 km. long with 150 sides closed to 0°1′ of azimuth and a computed error of 1 to 4500. Although the stadia constant had been carefully determined on the ground and all ordinary pains taken in running the line, the actual error (ascertained by checking on two geodetic points) was over five times as great as that computed. This line is typical of many others. Hence, where the expense is not unduly high, stadia lines should close on others of superior accuracy, even if determined only by a more careful stadia traverse run for the purpose.

The unavoidable errors are so great that it is almost never worth while to apply to side shots the focal length and horizontal distance corrections for vertical angles under 5°. For traverse distances more care may be needed, and the following hint should be remembered: When the wires are not set correctly (that is, the constant is not 100), a little table should be made out showing the corrections plus or minus, to be applied to the observed intercept for every 50 ft. of distance. This correction should include the focal length. For instance, at 800 ft., if the table shows a correction of —3 ft., and an intercept of 8.11 ft. is observed, the true distance will be 808 feet.

The general procedure for mapping areas up to 100,000 acres may be as follows: The positions of the towns are determined by triangulation and traverses run along the roads between them, taped for distances over 6 or 8 miles and measured by stadia if shorter. The topography is then taken by the most suitable method, running parallel lines not over ½ mile apart even in quite open country, closing on points of the road traverses. The elevations are controlled by levels along the roads, but it is not usually necessary to turn on the traverse points oftener than every two or three miles.

A Case of Quick Stadia Work

Recently the writer made an investigation for a pumped water-supply in the treeless hilly country in the southern part of the Province of Buenos Aires. The distance was about 5 miles; and as it was of course essential to know the difference of elevation, etc., a stadia line was deemed necessary. The afternoon before the day of the survey, four rods were made by a local carpenter. A height of 12 ft., instead of the 14 ft. usually convenient, was chosen on account of the extremely high wind blowing.

In spite of the violent wind and the untrained men—none of whom had ever seen a stadia rod—the line was run between 7 a.m. and 3.30 p.m. Twenty-three stations were occupied, and 60 side shots (including several triangulation shots) were observed. No plumb bob was used, and the stations were merely crosses marked in the earth or on the rocks, over which the instrument was set by eye. Ample sketches were made, and a map was plotted to a scale of 800 ft. to the inch (1:9600), showing a belt of topography 2000 ft. wide. The accuracy was quite sufficient for locating a pipe line; and if some horizontal and vertical control had been obtainable, the map would serve for more important constructions.

This was the first time in many years that the writer had made a survey in feet (the work was done for a new American enterprise whose officers are not yet familiar with metric measurements), and it was only the more convincing of the superiority for topographic work of the metric system. For elevations the decimeter (0.33 ft.) is a far better unit than 0.1 ft., and for distance the metric graduations are much easier to read and to count than feet.

In flat open country the writer has frequently used the following party: One man to carry instrument, one man to carry large umbrella and lunch, etc. (in hot weather), six stadia men (one back flag, one fore flag and four for side shots), sometimes headed by a foreman to keep in advance of the fore flag, picking points, etc., although this man is more useful when woods are encountered, in which case two side-shot men are replaced by axmen. With this party, which it will be noticed does not contain a recorder, the author once surveyed 3000 hectares (7500 acres) to the scale of 1:10,000 in one week; this was of course only possible by means of the control traverses and levels run along the main roads the week before.

In conclusion the writer would like to state that the best rodmen he has had in the Philippines and in South America have been local common laborers—after a day or two of experience. In the first place the work of tramping over hills seems to them an easy thing, and the newness and strangeness enhance the interest of the work and lend them an importance in the minds of their friends which tends to make them do their best. They have never any preconceived notions of how the rod should be held, nor does the back flag assume that you are through with him and sit down. Above all, they know local names, etc., and—*verbum sap*—in which fields savage animals are kept.

FINE AGGREGATE

Problem in Retracing Old Survey—A tract of land was laid out in 1791 in the course of subdividing a larger tract. Lying on the top and slopes of a rocky mountain, the tract was never fenced. The original corners have disappeared. The northerly boundary lies in a division line several miles in length and is marked by fences and old walls on either side of the tract in question. The northerly boundary can therefore be

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The writer suggested the use of some form of type-printing machine for the preparation of these tables and was authorized to investigate the matter. Various forms of typewriters were first tried out, but were found not entirely satisfactory. The adding machines already in the office were then tried, and it was found that these tables could be made by anyone familiar with the use of an adding machine in much less time than was required by an expert operator on a tabulating typewriter.

The computation of the data on the double form involved the addition of the daily discharge figures for a month; and this addition was made on the printer's sheet instead of on a list as formerly, so that the only work required for the preparation of these two tables consisted in tabulating the daily gage heights on the adding machine, an operation requiring about 10 min. In this way it is possible to prepare neatly typewritten printer's copy at a cost less than one-fourth that of the former unsatisfactory copy, and the new method has now been generally adopted by this organization.

On large irrigation projects, where a record is kept of the amount of water delivered to the water users, the tabulation of these figures involves a large amount of work. By tabulating the ditch-riders' reports on an adding machine the time required may be materially reduced, and more legible tables result. Also, the addition involved in the computation of results may be carried on at the same time the figures are being tabulated, thus saving one complete step.

Use for Multiplying and Dividing

The adaptability of the adding machine to multiplication is not generally realized. By treating any multiplication as a series of additions the exact product of any two numbers may be readily obtained on an adding machine[1]. The capacity of a nine-bank adding machine is as great as that of seven-place logarithms, and even on an eight-key machine a skilled operator can compete successfully with a user of logarithm tables. The construction of the ten-key adding machines is such that they are especially adapted to multiplication, and the use of long-hand multiplication, tables of products, or logarithms, can be entirely eliminated to advantage in offices equipped with such machines.

The process of division can be accomplished on any adding machine to advantage by the use of reciprocals. The intelligent use of significant figures is essential if adding machines are to be used to best advantage in computation. For a very large part of engineering computations not more than four or five significant figures are required in the results, and this makes the adding machine especially adaptable to this class of work.

A complete table of four-place reciprocals from 1 to 1000 may be readily tabulated on the machine itself and posted in front of the operator. In many engineering offices the character of the computations is such that a limited number of reciprocals and constants is used repeatedly. These may be tabulated and posted in front of the operator, but it will be found that they are involuntarily memorized by the computer who soon uses the machine almost automatically.

The work of the Government office above referred to involves the computation of monthly values for each of the rating stations for which data are published. These computations have been made with the aid of tables of products and conversion tables, and many of the computers have developed great speed in the use of these tables. The writer has found, however, that these computations may be made more quickly and with less effort on the ten-key adding machine, using a few easily memorized multipliers.

In building appraisal it is customary to compute the

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adding machine than when doing any other form of office work, and the momentum gained in the increased use of an adding machine invariably results in improving the general tone of the office work.

[1]See "Engineering News," Oct. 7, 1915, p. 703.

Methods and Accuracy of Results of Transit and Stadia Topography

By Cyrus Townsend Brady, Jr.*

For line surveys always, and for other work with inexperienced men, the writer considers the transit and stadia method preferable to any other. It is understood that the resulting map is to be plotted to the usual scales of from 400 up to 1000 ft. to the inch—that is, 1:4800 to 1:12000.

One important advantage comes from only one man being needed besides the rodmen. In many cases (depending on wages, etc.) it is more economical to put two parties in the field, when two surveyors are available, rather than to use them as instrumentman and recorder.

*United States Steel Products Co., Buenos Aires, Argentina, S. A.

Another advantage is the ability to work in unfavorable weather and in woods or tall grass and bushes, where the plane-table is cumbersome to handle or difficult to protect from tearing or wetting of the paper.

The method has two disadvantages: It is not possible to make sure that "holes" have not been left in the topography before plotting the map, and the sketches made in the field and the side shots are often insufficient for accurate drawing. The first objection at least can be met by plotting the principal lines before leaving the field; and by inspection any doubtful areas will be noticed.

This plotting of the lines brings up a great advantage of the method: The traverse is plotted from calculated

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the corrections plus or minus, to be applied to the observed intercept for every 50 ft. of distance. This correction should include the focal length. For instance, at 800 ft., if the table shows a correction of —3 ft., and an intercept of 8.11 ft. is observed, the true distance will be 808 feet.

The general procedure for mapping areas up to 100,000 acres may be as follows: The positions of the towns are determined by triangulation and traverses run along the roads between them, taped for distances over 6 or 8 miles and measured by stadia if shorter. The topography is then taken by the most suitable method, running parallel lines not over ½ mile apart even in quite open country, closing on points of the road traverses. The elevations are controlled by levels along the roads, but it is not usually necessary to turn on the traverse points oftener than every two or three miles.

A Case of Quick Stadia Work

Recently the writer made an investigation for a pumped water-supply in the treeless hilly country in the southern part of the Province of Buenos Aires. The distance was about 5 miles; and as it was of course essential to know the difference of elevation, etc., a stadia line was deemed necessary. The afternoon before the day of the survey, four rods were made by a local carpenter. A height of 12 ft., instead of the 14 ft. usually convenient, was chosen on account of the extremely high wind blowing.

In spite of the violent wind and the untrained men—none of whom had ever seen a stadia rod—the line was run between 7 a.m. and 3.30 p.m. Twenty-three stations were occupied, and 60 side shots (including several triangulation shots) were observed. No plumb bob was used, and the stations were merely crosses marked in the earth or on the rocks, over which the instrument was set by eye.

e sketches were made, and a map was plotted to a of 800 ft. to the inch (1:9600), showing a belt of raphy 2000 ft. wide. The accuracy was quite sufficient cating a pipe line; and if some horizontal and vertiontrol had been obtainable, the map would serve for important constructions.

is was the first time in many years that the writer nade a survey in feet (the work was done for a American enterprise whose officers are not yet fa- r with metric measurements), and it was only the convincing of the superiority for topographic work e metric system. For elevations the decimeter (0.33 s a far better unit than 0.1 ft., and for distance the e graduations are much easier to read and to count feet.

flat open country the writer has frequently used the ving party: One man to carry instrument, one man ry large umbrella and lunch, etc. (in hot weather), tadia men (one back flag, one fore flag and four de shots), sometimes headed by a foreman to keep vance of the fore flag, picking points, etc., although nan is more useful when woods are encountered, in case two side-shot men are replaced by axmen. this party, which it will be noticed does not con- a recorder, the author once surveyed 3000 hectares) acres) to the scale of 1:10,000 in one week; this of course only possible by means of the control rses and levels run along the main roads the week e.

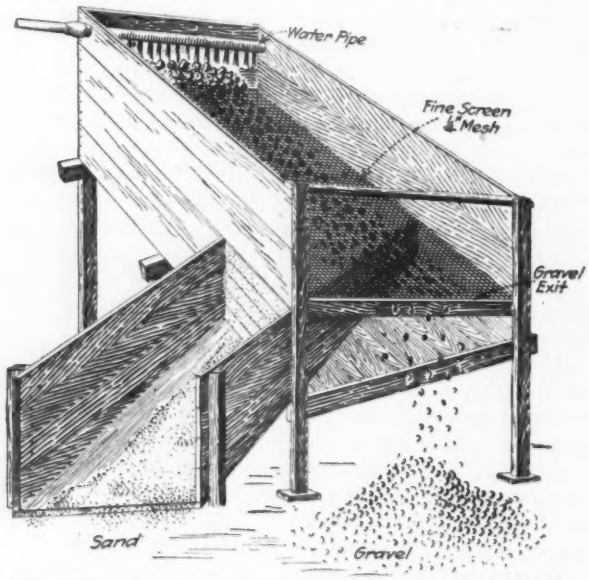
In conclusion the writer would like to state that the best rodmen he has had in the Philippines and in South America have been local common laborers—after a day or two of experience. In the first place the work of tramping over hills seems to them an easy thing, and the newness and strangeness enhance the interest of the work and lend them an importance in the minds of their friends which tends to make them do their best. They have never any preconceived notions of how the rod should be held, nor does the back flag assume that you are through with him and sit down. Above all, they know local names, etc., and—*verbum sap*—in which fields savage animals are kept.

FINE AGGREGATE

Problem in Retracing Old Survey—A tract of land was laid out in 1791 in the course of subdividing a larger tract. Lying on the top and slopes of a rocky mountain, the tract was never fenced. The original corners have disappeared. The northerly boundary lies in a division line several miles in length and is marked by fences and old walls on either side of the tract in question. The northerly boundary can therefore be

reproduced approximately. The sides of the tract, by description, make right angles with each other—that is, deducing the angles from the bearings. It is desired to reproduce the easterly boundary. Local surveyors say that, having allowed for the change in magnetic variation between 1791 and the present time, the northeast corner of the tract having been located, the proper procedure is to run the boundaries as needle lines. In other words, the direction is taken from the needle at each set-up. They claim that by so doing they are able to reproduce the line of the original survey. To this claim several objections may be raised: (1) Even allowing that the original needle pointings can be reproduced, unless the lengths of the different courses of the original survey are used, the resulting series of lines will be parallel to the original series, but not coincident; (2) it is not possible to reproduce the original needle pointings, on account of the daily variation of the needle and the variation due to different electrical conditions of the atmosphere. Since the field notes of the original survey are not available, the lengths of the different courses of the boundary and the hour of the day when run cannot be known. Why not run a straight line from the northeast corner, at right angles to the north boundary, for the east boundary, instead of the devious needle line, with an angle at every instrument point?—G. M. B.

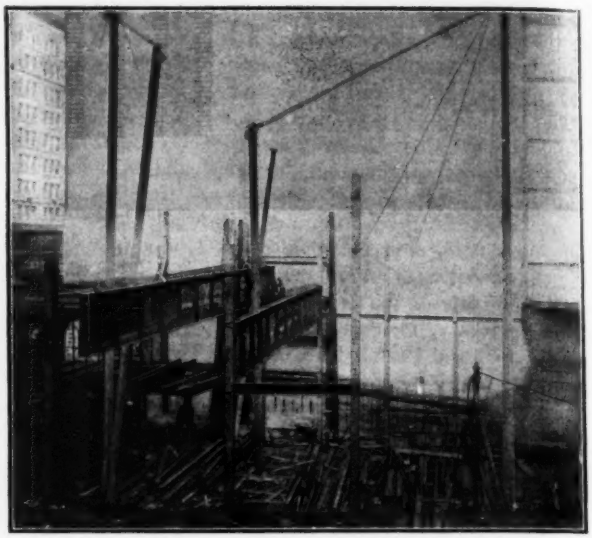
Small Screen and Washer—Frequently the material in a sand-and-gravel pit is first class, but the percentage of loam is too high and the proportion of sand to gravel is not right—requiring screening and washing. The device here illustrated is recommended for this purpose. It consists of a chute slanting at least 45°. A hillside is the best location; otherwise a platform should be constructed, to accommodate teams. The bottom of the chute slants to one side; this and a board nailed across the chute at the lower end deflect the sand to one side and keep it out of the way of the gravel, which comes straight down the chute. A fine screen placed about 12 in. below the top of the chute separates the gravel from the sand, while a pipe drilled with a row of small holes, staggered, delivers water that washes the loam from the sand



CONVENIENT DEVICE FOR WASHING AND SCREENING SAND AND GRAVEL

and helps in the screening. One of these devices was used with success on a large concrete job of which the writer had charge. Material containing 20% loam was passed over, coming out with less than 2%. The device should be located at the mixer, and plenty of water should be forced through the pipe. Two men can easily keep a 1-yd. mixer supplied.—G. M. Gilkison, 212 Highland St., Syracuse, N. Y.

Large Girders in San Francisco Theater—The two plate girders shown in the view are 8½ x 88 ft., weigh 35 tons, were fabricated in one piece and are said to be the largest assembled girders ever used on a building on the Pacific Coast. They support the balcony of the California Theater, in San Francisco, and were lifted 36½ ft. in 12 min. by two wooden guy derricks of special design. The derricks are made of 24 x 24-in. Oregon fir and have 90-ft. masts and 85-ft. booms. Both masts were anchored by ten 1¼-in. cables to concrete piers. Two cast-steel dogs, each weighing 250 lb. and fas-

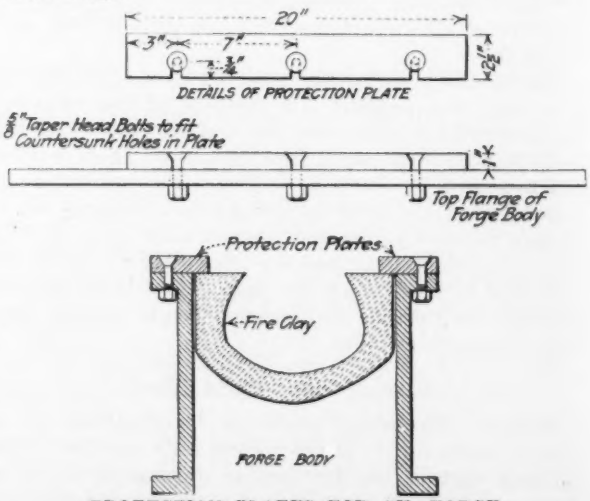


TWO 35-TON GIRDERS HANDLED BY SPECIAL DERRICKS, IN SAN FRANCISCO

tened to seven 1-in. steel cables, composed of eight strands of 19 wires each, were used to clamp and lift the girders and hold them in position until fastened to the 14 x 14-in. columns by means of drift pins, which latter were speedily replaced by ¾-in. rivets—78 on each end. The girders were fabricated by Jones & Laughlin, Pittsburgh, and were erected by the Dean Construction Co. under the supervision of J. J. Rosenthal, safety engineer, Industrial Accident Commission of California.

Careless Use of Small Electric Devices such as pressing or curling irons, toasters, electric pads, plate warmers and sterilizers has grown to sufficiently serious proportions to warrant the publication of a bulletin by the National Board of Fire Underwriters, 76 William St., New York City. Fires resulting from this form of carelessness are usually small, but the aggregate loss is large. The actuarial bureau of the board reports 100 such fires out of a total of 2000 losses in the day's report, and estimates that small electrical devices are causing 30,000 fires in the course of a year. Such fires are preventable.

Protecting a Clay Drill-Forge from damage resulting from dragging the bits in and out of the fire is done in the steel-sharpening shop of the Wisconsin Zinc Co., Platteville, Wis., by bolting 1-in. steel plates to the flange of the forge body, as shown in the sketch. The forge is of the oil-burning type made by the Denver Fire Clay Co., and has capacity for nine bits. According to J. E. O'Rourke—whose drill-sharpening article won a first prize in the recent "Engineering News" Contest—these plates protect the fireclay lining of the forge from damage.



PROTECTION PLATES FOR OIL FORGE

Editorials

Rendering Service to the Entire Engineering Profession

The consolidation of the Hill Publishing Co. and the McGraw Publishing Co., announced in *Engineering News* of Mar. 1, is an event of such importance and interest to the whole engineering fraternity that some comment upon it, and upon the process of evolution in the publishing business which has brought it about, is appropriate in this place.

In the consolidations which have gone on in manufacturing and commercial industries during the past twenty years, the governing motives as a rule have been the desire to eliminate competition with its attendant wastes, and, by capitalizing earning power, to sell properties to the public at a large profit.

Consolidation in the technical publishing field has come about through quite other causes. First among the influences which have tended to bring about consolidation have been printing office conditions. It can readily be understood that a single weekly journal cannot run its own printing office economically, for a plant and working force big enough to handle a weekly issue promptly on press days would be idle most of the week, except as it might enter the general competition for job printing to keep itself employed. In order that a publisher may conduct his own printing office—and there are many advantages in having full control of the printing operations—he is almost forced to issue a number of journals rather than one, in order to keep his printing costs on a reasonable level.

Again, what are generally termed overhead expenses may obviously be made less in a large organization than in a small concern issuing only a single publication. The advantages in capital, in security of investment, and in prestige are also all on the side of the large organization.

While these and similar considerations sufficiently explain the causes which have led to various publishing consolidations during the past dozen years, what is of most interest to the reader of engineering journals is the effect on the quality of service rendered.

If consolidation meant—as it has sometimes meant in commercial circles—that the public would be obliged to pay higher prices for goods or would receive poorer service, there would be good ground for protest. But in the publishing business more than in any other, the item of Good Will is not a mere generality of the accounting department but an actual asset, on which, in fact, the value of all the other assets depend. Any publishing enterprise which does not exert itself to render such a service to its subscribers and advertisers that it can retain their Good Will is headed for bankruptcy, no matter how large its capital or how distinguished its history.

Merely as a matter of sound business policy, in this as in any other consolidation of publishing interests, the management is bound to see that the new organization maintains at least the record of the old in service to its patrons. But the matter does not stop here. Those responsible for creating the McGraw-Hill Publishing Co., Inc., have behind them a long record of high achievement as publishers of the best in engineering journals. Their standards have not been the standards of the old-time trade journal, which was run as a purely commercial enterprise. They have aimed to make their journals leaders in their respective fields in promoting good practice and equitable dealing. That is still their aim.

It is a fact worth record that Mr. Hill, the founder of the Hill Publishing Co., began his work in technical journalism as an editor and continued in editorial work for many years before going over to the business side. Mr. McGraw, the founder of the McGraw Publishing Co., began at the very bottom in technical journalism and built up his journals with keen attention always to the character of editorial service rendered. Mr. E. J. Mehren, on whom as Vice-President and General Manager rests the conduct of the consolidated company, is a civil engineer by profession, and in his years of successful work as Editor of the *Engineering Record* has demonstrated to a wide circle of engineers, not only his ability in the conduct of a great technical journal, but also his high ideals as to the position of leadership which technical journals should occupy.

The journals which the McGraw-Hill Co. publish cover the fields of Civil, Mining, Mechanical, Electrical, and Chemical Engineering. It is difficult to overestimate the value of the service which this group of journals is capable of rendering to the engineering profession.

A Problem That Is Always with Us

Building a permanent and unyielding foundation is something of an unsolved problem. The engineer's increasing skill in design ever improves the superstructure, just as the architect's planning develops ever new styles of buildings. Both engineer and architect base their planning on the premise that a rigid and stable substructure will be had, to carry their superstructure. Their assumption often is belied by the results, and the point of the matter is that this is just as often the case today as in the times of the medieval constructors.

"Every first-class abutment that is a few years old has some cracks," an engineer recently said in public discussion. He was making a gentle charge against foundation practice fully as much as against our limited knowledge of retaining wall mechanics. Foundations settle, it is universally observed. But nobody has discovered, nobody has investigated, the factors determining this settlement. When and where we are to look for a settlement of ¼ in., when and where for a settlement of 2 in. or of 14 in., and how soon these settlements will develop—such questions have not yet been explored.

We know roughly that all soils are compressible and slightly elastic. We know that some soils show very marked viscous flow, and we suspect that all soils have plasticity in some degree, at least. Whether loading and the lapse of time will change a viscous soil to normal soil,

we do not definitely know. When pile foundations in the river silt at New York go down 3 or 4 ft. in the course of a couple of years, we are not able to explain the phenomenon nor can we predict it, except from identical experience in the identical soil. When the piles of a bridge foundation are pushed over by flow of near-by fill, as occurred last season at Baltimore, the condition again is one in which it is hard to predict, and hard to provide a certain cure. But the larger problem, because more commonplace, is that presented by ordinary good earth, as to whose load-carrying power and liability to settlement we have practically no figures—little more than some crude notions, enough to make structures safely stable, but not enough to keep them free from cracks.

We are in a sense at the threshold of development in this field of soil and foundation studies. What beginnings have been made are not promising; or, to state the fact more fairly, they have not yet shown a path by which the field can be explored. The mere fact, however, that superstructure knowledge has far outstripped substructure knowledge makes it certain that study must turn in the direction of the latter.

It is a satisfaction to contemplate the fact that engineering skill in constructing foundations has made great advances in the last quarter-century. This in itself gives some promise that we need not despair of mastering foundation soils. But for the present, earth foundations are a problem that is always with us.

Railway Traffic Congestion and Terminal Improvements

For fully a year now there has been congestion in railway transportation over a considerable part of the United States. In previous years when railway congestion has occurred, the trouble has usually been diagnosed as "car shortage," railway officers themselves have been slow to understand that "car shortage" is often a symptom rather than a disease.

In the railway blockade of 1916-17, however, the public as well as the railway officials has learned that the inability of a shipper to secure cars may be due to much deeper causes than failure of the railway company to own as many cars as its business demands. In fact the present railway congestion has been a remarkable object lesson, showing how obstruction at one point in the country's transportation system can cause congestion extending for thousands of miles.

The flow of freight traffic over the railway system of the continent is closely analogous to the flow of a liquid in a network of pipes, like that supplying a great city with water. If the flow is interrupted at any point, the current becomes stagnant for a long distance back from the point where the obstruction is placed. Delay in unloading freight at Atlantic seaports has kept cars tied up which should have been immediately released for the return journey; has filled yards and sidings; has made necessary the establishment of embargoes extending to the origin of freight in the far West in order to prevent entire stoppage of traffic; has interfered with the delivery of food, fuel, and manufactured products to hundreds of cities and towns; has caused hundreds of industries to run on part time, even though their goods were in urgent demand by consumers; and has sent retail prices of food products soaring in many cities.

How many millions of dollars of losses have been caused by the railway congestion of the past year it would be difficult to conjecture; but the public has certainly had a remarkable lesson as to the truth of the oft-repeated warning that ample railway facilities are even more necessary to prosperity than low railway rates.

It is without doubt the congestion of the past year that has led to the present agitation in many cities for the improvement of railway terminal facilities. This agitation comes not from railway officials but from leading commercial interests. Particularly notable is the agitation for the construction of municipal belt line railways and their operation on a plan similar to that adopted on the New Orleans Belt Ry., whereby all railways alike have equal use of the system. At Boston recently members of the Commission on the high cost of living declared that the New Orleans belt line plan ought to be adopted by Boston and that opposition of the municipal authorities to plans of the New Haven to enlarge its terminals must cease.

At Philadelphia, Director George S. Webster of the Department of Docks recently returned from an inspection of the New Orleans belt line and is making plans for the development of Philadelphia's present belt line railway so that it may be equally important and efficient. At Cincinnati a question of leading public interest is whether the Trustees of the Cincinnati Southern Ry., which was built and is owned by the city, shall take the lead in building extensive freight and passenger terminals. At Baltimore, the Pennsylvania R.R. has renewed its negotiations with the city for municipal legislation that will enable it to spend some $15,000,000 to increase the capacity of its lines through the city and its freight terminals. At New York, where congestion has been worse than at any other point in the country, discussion is still proceeding over the long delayed project of the New York Central to spend some $50,000,000 in enlarging its freight terminals. Leading engineers are interested, also, in the project for developing the traffic facilities of the entire Port of New York, on the New Jersey side of the river as well as the New York side and establishing a Port Commission to have charge of the entire work.

What is going on in the cities above mentioned is typical of the agitation which is going on in many other cities. The rebuilding and enlargement of railway traffic terminals promises to be as important a field of engineering work for the next decade as was the building of main line railways a generation ago.

The Federal Flood-Control Law

The Flood-Control bill passed in the closing hours of the last Congress establishes a new policy in river regulation for the Federal Government. Heretofore, all the work done by the Government on river and harbor improvement has been ostensibly for the improvement of navigation facilities. While the Government has expended millions of dollars on bank revetment works and levees along the lower Mississippi, it has been justified on the theory that both the bank-protection work and the levees were for the purpose of maintaining the navigable channel.

By the new law the Government definitely assumes responsibility for the control of floods in the Mississippi and

Sacramento Rivers. It makes, however, no appropriation for this work. That is left to future Congresses. The law directs the Secretary of War to carry on continuously, by hired labor or otherwise, the plans of the Mississippi River Commission for controlling the floods of the Mississippi and continuing its improvement from the Head of the Passes to the mouth of the Ohio River, "to be paid for as appropriations may from time to time be made by law." It is also specified that expenditures are not to exceed $10,000,000 in any one fiscal year nor $45,000,000 in the aggregate.

Since the present law carries no appropriation, it is difficult to see how the work could be carried on by hired labor until appropriations are made by a later Congress. It would be possible perhaps to let contracts for the work, the contractor taking the risk that the next Congress will make the necessary appropriations to pay for his work, failing which he would have to resort to the Court of Claims.

The question as to what action can be taken under the law is complicated also by the failure of the River and Harbor appropriation bill to pass. This bill carried an allotment of $6,000,000 for the work of the Mississippi River Commission, including the building and protection of levees. If the commission had had this large fund available, it might have gone ahead making surveys, estimates, etc., preparatory to letting contracts for levee construction under the Flood Control law. Of course, this work would naturally be postponed anyway until after the season of spring high water is over. By that time the new Congress, if it is called, may enact a new river and harbor bill or make appropriations under the Flood Control law.

Still another complication with the Flood Control law is that the Mississippi River Commission is required to assess upon the "local interests protected" (which doubtless means the levee districts), such a contribution as the commission shall determine to be just and equitable, but which shall be not less than one-half the Federal allotment for the work. This means a delay until these assessments can be made upon the levee districts, and the districts can make arrangements to float bonds to raise the necessary funds.

Similar restrictions govern the flood-control work on the Sacramento River, except that on that river the State of California is required to contribute a sum equal to that allotted by the commission from the Federal appropriation.

The third section of the new law was apparently intended by its framer to make possible surveys for flood-control work by the Federal Government on other rivers than the Mississippi and Sacramento, in the same way that surveys are made for river and harbor improvements. As passed, however, the law does nothing more than lay down a general policy; it names no rivers on which surveys are to be made and makes no appropriation for such surveys. It is of interest to note, however, that the law does specify that, when such surveys are made (presumably in accordance with acts and appropriations made by future Congresses), the survey and report must give data on "the possible economical development and utilization of water power and such other uses as may properly be related to the project."

It is of course true that the acts of one Congress are not binding upon its successors. The Sixty-Fifth Congress, with its very different political complexion, may possibly do nothing whatever toward carrying out the policy laid down in the Flood-Control bill. On the other hand there is a growing public sentiment that the Federal Government should take the lead in carrying out large national engineering works and in regulating such a great interstate stream as the Mississippi. The flood-control work laid down in the new law may mark the beginning of a new era in Government work on river regulation.

At any rate it puts official ban upon the pleasant fiction of so many years standing that *all* work on navigable rivers is a Federal responsibility under the broad interstate commerce clause of the constitution. A proper distinction between navigation and regulation is at last recognized by Congress.

Engineers Should Fight Untrue "Costs"

There is a vast deal of untrue cost reporting in this day and generation. By untrue we mean simply incorrect, whatever the underlying cause or motive. Much of this untruthfulness is due to unintentional incompleteness through ignorance, blundering or laziness, but some is deliberately designed to deceive. Engineers, who value their reputation for scientific accuracy and for professional honesty, should fight untrue cost reporting, regardless of its origin or object.

Flagrant examples of untrue cost reporting are apt to be found after changes from private to municipal ownership of water-works and other public utilities. In such case it is very common for cities to claim profits under municipal ownership, sometimes after considerable reductions in rates, when the fact is that inadequate allowance, and in extreme cases no allowance at all, has been made for capital charges. Similarly, cities changing from street cleaning or garbage disposal by contract, will compare contract prices with the "cost" of the municipal service, and make absolutely no allowance for interest and depreciation on plant and equipment. An example of this occurred in the first statement of the results of the operation of the Cleveland garbage-reduction works under municipal ownership, although a footnote naïvely gave warning to the wary that interest on bonds was not included because it was taken care of by another city department. Later reports, it is only fair to say, included an allowance for all capital charges.

Engineers can appreciate the obligation of cities to include capital charges whenever comparing public with private ownership of utilities, or results under contract construction of sewers or pavements or contract service in street cleaning, garbage collection and disposal with force-account results. The average city official, however, seems unable or unwilling to take all the elements of cost into account when he is reporting the cost of almost any service rendered by a city. What city accounts, to go into quite another field than any of those mentioned, include in the statement of cost of the public schools the interest charges and depreciation on the investment in school buildings?

Since the engineer can and does appreciate all the elements of cost far better than the average city official or citizen he should take pains to see, each in his own city or state, that true and full costs are reported instead of dishonest or partial costs.

Letters to the Editor

"Rocmac" as a Pavement Foundation

Sir—Our attention has been directed to a note that appeared in "Engineering News," Jan. 18, p 116, quoting from a paper read by George C Warren, president of Warren Brothers Co., Boston, Mass., at the meeting of the engineering section of the American Association for the Advancement of Science, on Dec. 28, 1916. Mr. Warren stated that as the result of considerable investigation his company has found that a "Rocmac" foundation is entirely satisfactory for use under bituminous wearing surfaces. He stated further that his company has successfully laid approximately 10,000 sq.yd. of wearing surface over a foundation made of silicate of soda and crushed stone; and he has found that the silicate of soda or "Rocmac" concrete has greater resiliency and less rigidity than portland-cement concrete and apparently materially lessens, if it does not entirely overcome, the cracking troubles of portland-cement foundations.

In connection with this extract from his paper, the editor comments on the solubility of silicate of soda in water. He also comments on the fact that silicate has been used to some extent in road pavements under the trade name "Rocmac," which is a mixture containing sugar, powdered limestone and other ingredients.

In making this comment we fear that the editor has unintentionally made a statement that may give a wrong impression. In the first place, silicate of soda, while soluble in water, is dissolved with difficulty. Silicate is produced by melting sand and soda ash in a furnace similar to that used in the manufacture of window glass. The first stage is complete when the glass is drawn from the furnace and allowed to cool. To put this in solution form requires the use of quite an elaborate apparatus, and the glass is dissolved at a high temperature to whatever density of solution is required. On exposure to the air this solution parts with water by evaporation, and the silicate becomes very hard and very difficult to dissolve again under ordinary conditions. The foregoing is mentioned only parenthetically.

In the manufacture of silicate of soda a number of different grades are made, the quality being determined by the use to which it is to be put. After long experiment a special grade has been prepared for use in road building, and to this has been given the trade-mark name "Rocmac." In using it, "Rocmac" solution is combined with fine-ground limestone (carbonate of lime) and crushed stone. There is a series of chemical reactions which follow the combination, resulting in the formation of an insoluble cement, or matrix, that holds the crushed-stone aggregate securely in place.

We feel quite sure that your readers will be interested in this statement as a matter of information in regard to "Rocmac" roads. Sugar is not used in the combination at all, although patents have been taken out covering the theory of using sugar in the mixture.

WILLIAM TOWNSLEY,
General Manager, the Rocmac Co.

Cleveland, Ohio, Feb. 20, 1917.

[In the paper referred to, Mr. Warren did not mention "Rocmac" by name, and the reader had no reason for concluding that the silicate of soda concrete to which Mr. Warren referred was identical with "Rocmac." The definition of "Rocmac" given in the note under discussion is taken from a statement in the authoritative 1916 "Good Roads Year Book," p. 384.—Editor.]

More Light on Boston High-Pressure Fire-Service Controversy

Sir—Our attention has been called to the letter of the commissioner of public works, E. F. Murphy, of Boston, Mass., in "Engineering News," Feb. 22, in which he takes exception to statements concerning the high-pressure fire service in that city, which appeared in "Engineering News" of Jan. 11, in comment on a report by the National Board of Fire Underwriters.

You have adequately disposed of Mr Murphy's statement as to the 17 discharged employees except that you might well have quoted further from the findings of the judge of the Dorchester Municipal Court: "I find that the underlying motive for the change was purely political, with the primary object of getting rid of these petitioners and other obnoxious employees . . ."

As is probably known to many of your readers, the "engineering inspector" mentioned in Mr. Murphy's letter is Clarence Goldsmith, whose qualifications include a degree from the Massachusetts Institute of Technology and membership in the three leading American engineering societies, civil, mechanical and electrical.

The position of engineer in charge of the high-pressure fire-service system was at no time sought by Mr. Goldsmith, nor for him by the National Board. In August, 1911, the then mayor of Boston approved his appointment upon recommendation of the then commissioner of public works, who had previously ascertained, largely by personal observation during a three months' study of conditions in Boston by National Board engineers, the qualifications of the appointee and his willingness to accept the situation. During the 2½ years following August, 1911, plans and specifications were perfected and much development and experimental work accomplished. At the time the first contract for pipe laying was about to be let, early in March, 1914, the present mayor refused to approve the certification necessary for Mr. Goldsmith's further employment.

The pipe-laying contract was let, and on June 5, 1914, the then commissioner of public works, with the approval of the present mayor, again sought the services of Mr. Goldsmith, who consented to return only with the understanding that he should be retained until the completion of the system and that work should be pushed rapidly. The position entailed long hours and much responsibility and could not, under the conditions then prevailing, be considered as congenial or desirable, nor did it afford any greater salary than Mr. Goldsmith had been receiving.

The work performed under the pipe-laying contract failed in many instances to meet the specifications, and in January, 1915, the engineer in charge sent a letter to the commissioner of public works, setting forth in detail the deficiencies in the work; a copy of this letter was filed with the Finance Commission of the City of Boston. Notwithstanding the advice contained in this letter, that no further work of this inferior nature be allowed, the same class of work was continued during the succeeding season. However, the engineer in charge refused (except in one instance) to approve any of the monthly estimates for payment on this contract. That his contentions were correct is proved by the amount of work his successor has had to do to make this part of the system satisfactory.

The only misstatement of fact brought to my attention, or of which I am aware, in our report of December, 1916, is that an allowable leakage of 4 gal. per lin.ft. of joint in 24 hours is about double that allowed on any similar system. The New York specifications allow 4 gal. leakage; but those for other similar systems allow considerably less, and, so far as we have been advised, it has been possible to secure satisfactory compliance with these specifications.

The statement to which Mr. Murphy objects was not made the basis for any criticism in our report, as we did not and do not now consider a maximum allowable leakage of 4 gal. per ft. of pipe joint high enough to be particularly objectionable. Much stress was laid on this misstatement, both in Mr. Murphy's letter and the public hearing to which he refers, with the evident intent to distract public attention from other and really vital parts of our report.

GEORGE W. BOOTH,
Chief Engineer, National Board of Fire Underwriters.

New York City, Mar. 1, 1917.

New Curb and Step Forms—The address of the maker of these forms, described in "Engineering News," Feb. 15, p 296, was given as Cincinnati, Ohio. The correct address is the H. D. Cornelius Co., 3012 Calvelage St., Indianapolis, Ind.

Gates and Valves of the Elephant Butte Dam (correction)—The article in "Engineering News" of Feb. 22 stated that the transition castings of the penstock conduits were made by the Eddy Foundry Co., of Milwaukee, Wis. They were made by the R. M Eddy Foundry Co., of Chicago, Ill.

Another Street Tunnel To Be Built in Los Angeles

By R. W. Stewart*

The long-discussed Second St. tunnel through "Bunker Hill," in Los Angeles, Calif., has at last been definitely authorized. Work on it will probably begin in two months.

The extension of suitable avenues of traffic through the hill which bounds the older business district on the north and west has long been a civic problem in Los Angeles. Streets passing over the hill to the west have grades of 11½% or more. In 1900 tunnels were bored at Third St. and Broadway, these being described in *Engineering News*, July 18, 1901, p. 35. The grades approaching the original Broadway tunnel being objectionable, it was underpinned in 1915, one end being lowered 20 ft. (*Engineering News*, Mar. 2, 1916, p. 414.)

Since the advent of the automobile the Third St. tunnel has been badly congested, and additional tunnels have been proposed for First, Second, Fourth and Fifth Sts. Two other projects which received serious consideration were (1) cutting down the entire hill west of the business district, and (2) opening a cut more than one block wide through the hill which would include First and Second Sts. and all abutting property.

The last mentioned cut, which was only a fraction of the first, would have been 90 ft. deep, involved the removal of 3,741,000 cu.yd. of earth through well populated surroundings, and required wrecking the buildings (some of which were high-class) which occupied a majority of the lots over the site of the cut.

Second St. tunnel has finally been selected as the most feasible step toward improving traffic conditions west from the city. On Feb. 7, 1917, the City Council passed the ordinance ordering its construction. Bids will be received on Mar. 26.

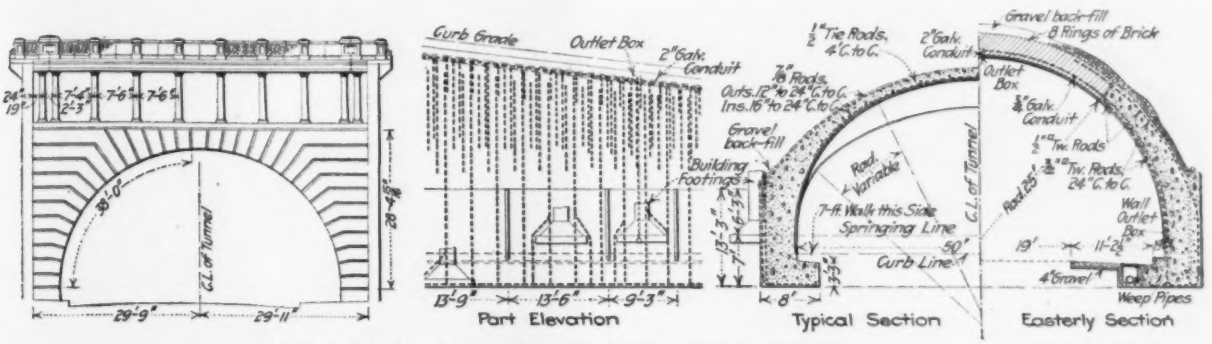
Work To Be Paid for by Assessment

The tunnel will be financed by special assessment on a large area comprising the northerly retail and wholesale district, and residential territory westerly thereof which is fenced off from the city by the hill.

Second St. is 60 ft. wide; the tunnel will be 50 ft. wide in the clear. The greater part of its length will have a semicircular arch with the springing line 3 ft. above the roadway, this making the tunnel 28 ft. in height. To let Clay St. pass over the tunnel near its easterly portal its height is tapered down to 20½ ft. in a distance of 64 ft., the width at the springing line remaining constant. Near the center of the tunnel will be a slight angle. This is due to the necessity of following the lines of Second St., some property owners on the hill not having been willing to give easements under their lots and condemnation procedure being slow and unsatisfactory.

The tunnel will be lined throughout with white enameled tile and well lighted. Its principal structural features are as shown by accompanying figures.

The portal wall at the west end will be set back some distance on the barrel of the tunnel and will support one edge of a reinforced-concrete sidewalk slab whose other edge will be supported by a colonnade flush with the end of the tunnel. This will avoid great increase in foundation pressures at the end due to earth thrust against the portal. Both portals will be faced with artificial stone.



SOME DETAILS OF SECOND ST. TUNNEL AT LOS ANGELES, CALIF.

A new street detouring the easterly tunnel portal on its northerly side is being opened to give access to the top of the hill.

Damages will have to be paid to property owners fronting the approach cuts. The tunnel will cost about $800,000.

Chicago Subway Design Outlined

Design and construction of the proposed subways at Chicago are included in the Chicago Traction and Subway Commission's comprehensive report, which has recently been made public.

The State St. rapid-transit subway is to accommodate the elevated-railway trains and to form a north-and-south route through the congested district of the city. It will be about 3 miles long, from 18th St. to Chicago Ave. at Franklin St. The profile will follow that of the streets, except that 3% grades will be used for the connecting inclines at each end and for the approaches to the tunnel under the river.

The level of base of rail is about 18 ft. below the street. This provides for two-level construction at the intersections with surface-car subways and the future low-level crosstown rapid-transit subways. The tunnels of the Illinois Tunnel Co. have their arches about 33 ft. below the street, and this determines the elevation of tracks of the two intersecting subways above the tunnel. Except for this limitation it is stated that the

*Engineer of Bridges and Structures for the City of Los Angeles, Calif.

depth from street to base of rail should be at least 21 ft. This would simplify the restoration of subsurface structures and reduce the noise from surface traffic. On the other hand, the shallower construction reduces the amount of excavation and reduces the height of stairways.

The material encountered is such that great care will be required in construction to prevent movement and excessive drainage of adjacent ground. As the excavation will be below the shallow types of building foundations, such buildings must be underpinned or the trench inclosed by water-tight sheeting to sustain the lateral pressure of the saturated earth and clay. For the low-level street-car subway the depth of trench would be about 33 ft., but it is believed that the subways can be built without damage to the streets or building. It is pointed out that the subsoil conditions are quite different from those in other cities where subways have been built.

The report states that in the business streets it is proposed to carry on the subway construction beneath a deck of heavy planking that will temporarily form the street surface. The work would be done in short sections, so as to avoid long stretches of excavation. For the low-level subway a similar method is proposed.

Structural Design Mainly of Steel

The structural design includes steel columns and roof beams, forming bents spaced 5 ft. c. to c., with a reinforced-concrete floor and concrete jack-arches between the roof beams and wall columns. The report states that experience in New York indicates this design to be generally preferable to a reinforced-concrete design, particularly where the construction is carried on under important business streets. It is more conveniently and quickly erected and is more economical. The design for the low-level subways is similar, but with heavier sections and perhaps with I-beam reinforcement in the floor. A waterproofing membrane of woven fabric laid in pitch or asphalt is provided, but for the low-level subway it may be necessary to use bricks laid in asphalt mastic.

The stations are to be 450 to 500 ft. long (for 10-car trains), with a minimum platform width of 12 ft. Passenger subways will connect the platforms. Electric cables are to be laid in ducts built into concrete benches along the side walls, these benches forming emergency footwalks in case of accident or of trains being stalled. For ventilation, the subway will be divided longitudinally by a curtain wall, so that air will be expelled in front of a train and drawn in behind it. Reconstruction of sewers will be necessary, but will not be a difficult problem.

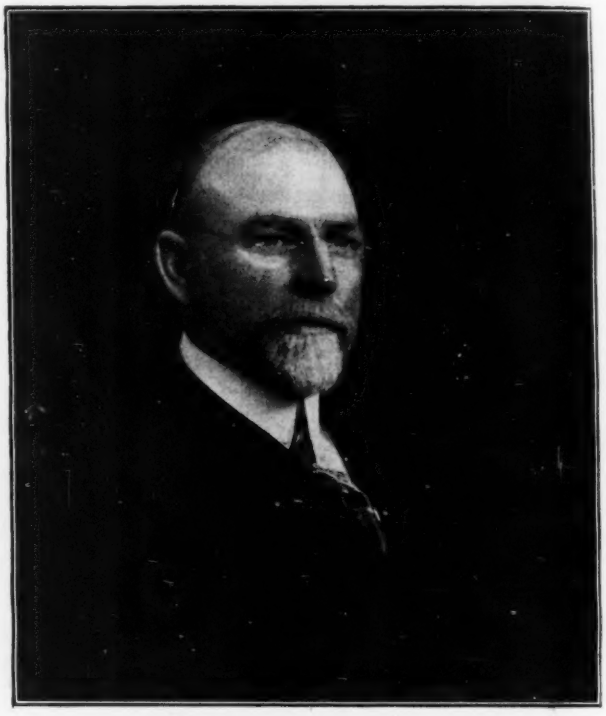
It is proposed also to lay water and gas mains, electric conduits and other subsurface structures in the soil on either side of the subway. A special difficulty occurs at street intersections, where galleries may be required to carry the utilities across or under the subway and where the available space is very shallow. By means of small I-beams placed between the main roof beams the depth of cover may be increased sufficiently for cross-connections of the smaller utilities separated by the subway.

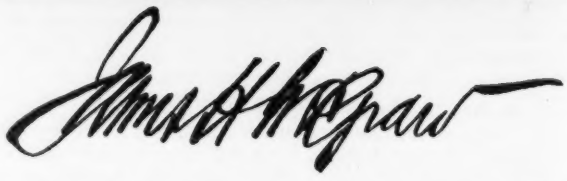
The tracks between stations are to be of ordinary construction, with ties in stone ballast. The stations are to have unballasted tracks, with rails laid on blocks set in recesses in a concrete floor. This will provide for cleaning the floor by flushing or sweeping.

James H. McGraw

For more than a quarter of a century, James H. McGraw, who now becomes the President of the McGraw-Hill Publishing Co., Inc., has been a prominent figure in the field of technical journalism.

In the late '80's, three young men, who had come to New York City from country towns only a short time previous, were associated in publishing three small journals, called *Power*, the *Street Railway Journal*, and the *Journal of Railway Appliances*. The three men were Emerson P. Harris, H. M. Swetland, and James H.





McGraw. Of the three, Harris was the pioneer in establishing the journals and he brought the other two young men from their homes in western New York first as employees, and later (since the business was at that time too impecunious and uncertain to stand much in the way of fixed salaries) as partners. In a short time Mr. Harris sold his interest to the other two men and a separation occurred. Mr. Swetland took the journal *Power*, built it up to a commanding position and sold it in 1902 to the Hill Publishing Co. Mr. McGraw retained the other two journals. His choice was fortunate, for the street railway business was just beginning to be revolutionized by the introduction of electricity. To the engineers who swarmed into the street railway business when the horse car era ended, the *Street Railway Journal* was a necessary aid.

The prosperity of the publication gave its owner the means to extend his enterprise into broader fields. His

acquaintance with the electrical field through street railway work naturally led to his interest in electrical publications. Here there prevailed during the '90's severe competition, and bitter personal rivalries as well. In 1896 Mr. McGraw bought a journal called *Electrical Industries*, which he renamed the *American Electrician;* three years later he purchased the *Electrical World* and the *Electrical Engineer*, and consolidated the three papers as the *Electrical World*.

In 1902 he purchased from Henry C. Meyer the *Engineering Record* and about the same time began the publication of a journal devoted to electro-chemistry, which since 1915 has been issued under the title *Metallurgical and Chemical Engineering* as a semi-monthly. A year ago the widening interest in the electrical field made advisable a division of interests. A journal, *Electrical Merchandising*, was established on the foundation of a small independent journal in that field which was purchased. Quite recently two journals in Chicago devoted to contractors' interests have been purchased and are now issued as *The Contractor*.

In the early days of technical journalism, offices in a down-town office building—and very modest offices at that—sufficed for most journals. With the growth of the business and the establishment of printing facilities, enlarged quarters became necessary. In 1906 an 11-story reinforced-concrete building on West 39th St. was built by Mr. McGraw as a home for his publications; but the lapse of only a few years made necessary an addition as large as the original structure.

Mr. McGraw has always taken an active interest in the industries represented by his journals. He has been especially prominent in the electrical field and is an Associate of the American Institute of Electrical Engineers. He belongs to the Engineers Club, the Railroad Club, the Republican Club and the Aldine Club in New York City. He has resided for many years at Madison, N. J., and is President of the Board of Directors of the Madison Academy.

E. J. Mehren

The choice of Mr. E. J. Mehren, Editor of the *Engineering Record*, for the position of Vice President and General Manager of the newly organized McGraw-Hill Publishing Co., Inc., is a noteworthy promotion of a civil engineer, comparatively young in years, to an executive position of great responsibility.

Mr. Mehren graduated from the civil engineering course of the University of Illinois in 1906, having completed the course in three years of study. His first engineering work was on the locating survey of the Chicago, Milwaukee & St. Paul's extension to Puget Sound; but after a few months an opportunity opened to gratify a desire to undertake work in engineering literature. He came east to New York and began work as an associate editor of the *Engineering Record*.

After four years in this position he was offered and accepted the position of manager of the Emerson Co. of New York (Harrington Emerson, president), efficiency engineers. After little more than a year in this new position he was invited to return to the *Record* as its managing editor and he was made editor-in-chief in August, 1913.

Mr. Mehren's progressive work in his conduct of the *Engineering Record* has made him widely known to the engineering profession. At the close of last year, two important executive officers, Mr. S. T. Henry and Mr. H. M. Wilson, retired from the McGraw Publishing Co., and in January Mr. Mehren was made vice-president of that company. When the recent consolidation of the McGraw Co. and the Hill Co. was effected and the problem arose of finding a man in the two organizations capable of taking the executive responsibility of welding the two organizations into a harmonious working unit, the choice fell upon Mr. Mehren.

Mr. Mehren is intensely interested in the technical side of his profession and especially in the development of

E. J. Mehren

higher standards of conduct and practice and greater achievements in public usefulness by engineers. It surely means much to the entire engineering profession to have an engineer with such ideals and attainments placed in full charge of the greatest engineering publishing house in the world.

Petroleum Production in 1916—Preliminary estimates by John D. Northrop, of the United States Geological Survey, Department of the Interior, indicate that the quantity of crude petroleum produced and marketed in the oil fields of the United States in 1916 was 292,300,000 bbl. This quantity is greater by 4% than the corresponding output in 1915, which reached the record-breaking total of 281,104,104 bbl. Mr. Northrop estimates that 38% of the 1916 total came from the Oklahoma-Kansas field, 30% from California, and the remaining 32% from the Appalachian, Lima-Indiana, Illinois, north Texas, north Louisiana, Gulf coast, and Rocky Mountain fields.

News of the Engineering World

Metropolitan City Planners Confer

An informing and inspiring conference on city and village planning in the Metropolitan District was held in New York on the afternoon and evening of Mar. 10. Strange to say, this was the first conference of the kind held to consider the planning problems that are common to New York City and the adjacent territory. Very appropriately, the conference was held at the City Club, 55 West 44th St., which is rapidly becoming the headquarters for conferences on municipal problems, not only for the Metropolitan District but for the whole country.

The keynote address was delivered to the conference by Nelson P. Lewis, Chief Engineer of the Board of Estimate of New York City, who also acted as Chairman of the afternoon session. The evening session of the conference was presided over by Frank B. Williams, Chairman of the Committee on City Planning of the City Club. A committee on plans for future action was appointed to report to a second conference to be called within two months or so. The members of this committee are Messrs. Lewis and Williams, for New York City; Herbert Angell, Mt. Vernon, N. Y., a member of the Westchester County Planning Commission, for the outlying district to the north; Oscar Maddaus, Mineola, N. Y., Secretary of the Nassau County Association, for the eastern outlying district; and Arthur P. Cozzens, Newark, N. J., Secretary of the Newark City Planning Commission, to represent northern New Jersey.

In his keynote speech, Mr. Lewis spoke of the interrelations of city and town planning in the Metropolitan District. It heretofore has been quite lacking, each city and town not considering the subject beyond its own city limits. Coöperation is eminently desirable. There has been some coöperation in the matters of water-supply and sewage disposal within the Metropolitan District, but practically none in the layout of a comprehensive metropolitan highway system or visible city plan. There is a deplorable lack of highway outlets from New York City to the north.

Various phases of city planning in New York City and its boroughs, and also in the outlying districts in Westchester County to the north, Nassau County to the east, and in the five counties of northeastern New Jersey to the west and north, were outlined by a score or more of speakers. Harry Meixell, Jr., after deploring the fact that in the great highway system established by a recent act of the New Jersey Legislature, the routes have been selected by legislative log rolling instead of in accordance with any scientific planning principles. Mr. Meixell also spoke of the need for broader legislation in New Jersey, illustrating his point by a statement that a bill recently introduced having some relation to city planning related in the first instance to Newark and Jersey City only. Subsequently it was enlarged to include all cities in the state, but there are only some 40 odd of these, whereas the powers granted in the bill are needed by boroughs and towns to a much larger number.

The need of better suburban transit service was forcibly presented by John T. Fox, transport expert to the Committee on City Plan of the Board of Estimate. The completion of the dual subway will vastly improve transit service within the city, but altogether too much time and too many changes of cars are required to get from the city to many suburban points, and particularly to get from say, White Plains, N. Y., to Westfield or to Morristown, N. J. Even a trip from the New York Central to the Delaware, Lackawanna & Western within New York City is exasperating in point of time and inconvenience if reliance is placed on transit facilities. Every railroad out of New York, Mr. Fox went so far as to say, ought to run trains under 20-minute headway. Whether through trains across the city can ever be secured is uncertain, but there at least ought to be better connections and less waiting.

David Grotta of the Newark Planning Commission not only gave an interesting and instructive account of some of the work done by that commission, including conferences with representatives of outlying districts, but showed such fervor and zeal for city planning as means of community and intercommunity benefit as to inspire those attending the conference to greater efforts in behalf of their own community. L. L. Tribus, of the Borough of Richmond, New York City, told of city-planning work, including a very elaborate topographical survey, carried out while he was Chief Engineer of the Borough.

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Pennsylvania R.R. Has New Employment System

The Pennsylvania R.R. has put into effect a new scheme of handling applications for employment, intended to encourage applications from more men who live in the vicinity of its lines and shops. Each of the road's 1500 station agents on the lines east of Pittsburgh and Erie becomes virtually an employment agent. There is also an employment clearing house established in the General Manager's department at Philadelphia.

Notices are to be posted conspicuously along the railroad directing all persons desiring employment to see the nearest station agent. The agent is instructed to see each applicant, to learn his capabilities as fully as possible, and to direct him to the nearest shop foreman, supervisor, trainmaster, or road foreman of engines, who are apt to have vacancies in their forces. If there are no vacancies found on the division in which the application is made, the papers are forwarded to the office of the General Manager in Philadelphia.

The General Manager's office, under the clearing house scheme, receives each week from each General Superintendent a list showing the vacancies on his division, covering shop laborers, car repairmen, car cleaners, engine cleaners, brakemen, firemen, freight handlers, trackmen, etc. This results in being able to direct every applicant to the nearest point where opportunity exists.

Railway Officials Formally Dedicate Hell Gate Bridge and Viaduct

The great Hell Gate Bridge and viaduct of the New York Connecting R.R. was dedicated on Mar. 9, 1917, by a party of high officials of the Pennsylvania R.R. and of the New York, New Haven & Hartford R.R., owners of the New York Connecting R.R. A. J. County, Vice-President of the Pennsylvania, opened the brief ceremony. The designer of the structure, Gustav Lindenthal, Chief Engineer of the New York Connecting R.R., responded, turning the structure over to Samuel Rea, President.

Mr. Rea referred to the formation of the company 25 years ago, to the four years of construction work, just completed, and to the great cost of the enterprise—over $27,000,000. He then said the line was transferred to the New Haven for operation as part of its system, to replace the river service for connection between the New England states and the states west and south. E. C. Buckland, Vice-President of the New Haven, accepted for the latter.

The first service over the new line will be the operation of the Federal Express, the long-established through night train between Washington and Boston. This train was transferred by car ferry between Port Morris and Jersey City, across New York Harbor, until Oct. 19, 1912, when it was operated over Poughkeepsie Bridge instead, and the car ferry was discontinued. On Jan. 9, 1916, however, the train was wholly discontinued, except that it was resumed as a weekly train for a short period in the summer of 1916, to enable through travelers to bypass New York during the infantile paralysis epidemic. The train will be restored by the new Hell Gate line about April 1, 1917.

The New York Connecting R.R. is a four-track line about 6 miles long, most of it on steel viaduct and bridge, and the rest on concrete-walled approach. Its main structure is the Hell Gate steel arch, 977½ ft. in span c. to c. skewbacks. There are also important crossings over Little Hell Gate and Bronx Kills.

Ontario Hydro-Electric System Operations in 1916

A statement of the operations of the Ontario Hydro-Electric Power Commission for the year ending Oct. 31, 1916, has been issued by the chairman, Sir Adam Beck. The figures for the Niagara system are: Total average horsepower used 109,583; average cost per horsepower at Niagara Falls, $9.10; total capital cost of system, $9,522,995; interest paid from earnings, $371,404; maintenace costs, $180,962; operating costs, $137,333; cost of power $997,257; total expenses, $1,686,958; total receipts, $2,038,792, leaving a surplus of $351,833. Deducting the sinking fund due on capital cost, amounting to $167,132, a balance of $184,701 is then applicable to the reserve fund.

These figures might warrant a general reduction in rates but this is considered unadvisable in view of the increased cost of a large additional block of power to be supplied this year by the Canadian Niagara Power Co., at $12 per hp. and because of the outlay required for the construction of a duplicate transmission line from Dundas to Toronto.

The Severn district system serving Midland, Collingwood, Barrie, and other towns in that part of the province, showed a net surplus of $26,377 on the year's operations, after paying interest and sinking fund charges. The Port Arthur system had a surplus of $20,862. The Eastern system including the plants taken over from the Seymour interests in the Peterborough district, showed a small operating profit.

Strange Accident on Elephant Butte Dam Causes Two Deaths

An extraordinary accident inside of the large Elephant Butte dam in New Mexico caused the death of two of the power house attendants recently. One of the power house attendants, F. O. Babcock, went on duty and was to be relieved by another attendant an hour or two later. When this attendant went to the power house he could not find Mr. Babcock so went through the gallery inside the dam looking for him. At the air inlet chamber of the west upper valve he found Babcock and H. E. Reid standing with their faces to the wall, dead. Their bodies were apparently held in place by the suction through the air inlet tube. Babcock's right arm was extended into the tube as if he might have been pointing out something to Reid. It is probable that the latter approached closer to see better and his overcoat and the two bodies practically closed the opening, so that the suction due to the vacuum in the tube not only held them both fast to the inlet, but exerted a pressure of some 6000 lb. on that part of their bodies exposed to the action. To release the bodies, the other attendant had first to close the valve. The valves and their layouts were described in *Engineering News*, Nov. 30, 1916, p. 1015.

Blue River Improvement, Kansas City

Preliminary plans for the first steps in a scheme to improve the Blue River within Kansas City, Mo., were approved by the Board of Public Works of that city on Feb. 9. The full scheme, as thus far worked out by Harrington, Howard and Ash, consulting engineers, Kansas City, provides for three low dams to lessen flood conditions and prevent mud-bank exposure at low water; a 140-acre lake; a parked area along the river; boulevards; river canalization and an industrial area, the two last-named below the lower dam.

The Blue River has a drainage area of 275 sq.mi., most of which is outside the city; a maximum flow estimated at 30,000 cu.ft. per sec.; practically no dry-weather flow except the discharge from domestic sewers, which will be diverted by a proposed intercepting sewer, plans for which are being made. The stream enters the city through Swope Park, the largest of the city parks, in the southwest corner of the city, and flows to the Missouri River through alluvial sparsely settled land. The Missouri has a maximum fluctuation in level of 32 ft. and the Blue River of 40 ft., the latter between high muddy banks in Swope Park.

In 1912 the Park Commission, advised by Robert C. Barnet, consulting engineer, recommended a single dam, a lake and boulevards. In 1915 a bond issue of $100,000 to start the improvement was voted, the money to be spent by the Board of Public Works.

The present scheme proposes a dam near 10th St., with a crest at El. 9 (city datum) or 10 ft. above low water; a second dam at 19th St., with crest at El. 21 or 12 ft. above backwater; and a third dam south of the mouth of Brush Creek, with crest at El. 30, or 9 ft. above backwater. The second dam is on the site of the one proposed in 1912. Each dam would be provided with sluice gates, for equalizing water levels and for flushing out silt, which is recognized as a serious problem. Even with the sluice gates closed the stream fluctuation would be reduced to a maximum of 12 ft. and a normal of about 6 ft.

The immediate expenditures recommended are the securing of part of the needed land; building a timber and rock dam at 10th St., with sheetpiling to stop seepage, and a marine railway, at an estimate cost of $40,000 to $45,000; some levee work; and snag removal the whole length of the river. It is also advised that Congress be requested to order an examination of the Blue River from its mouth to the site of the first dam with a view to having this part of the river canalized at Federal expense.

Pollution of the Passaic River by Paterson, N. J., may continue two years more, through an extension of time granted by the court. Riparian owners who had sued Paterson for sewage pollution were awarded damages in 1908, the claims to hold until 1911, when it was then thought that the Passaic Valley trunk sewer would be completed. Extensions have since been made until 1913, 1915 and 1917, and now until 1919.

A System of State Highways in New Jersey, to be constructed during the next five years at a cost of $15,000,000, is practically assured as a result of Senate action on Mar. 8 in passing the Edge tax bill, providing for a tax of one mill on every dollar of assessable property in the state. The bill had been amended in the House to exempt corporations having annual receipts of less than $5000. The bill has gone to the Governor for signature.

Illinois State Departments are reduced from 130 to 9 by a bill that passed the Legislature about Mar. 7. The new departments are: Finance, Agriculture, Labor, Mines and Mining, Public Works, Charities and Corrections, Health, Corporate Control, Education and Civil Service. It is reported that the act "wipes out about 300 jobs and sinecures" and will effect a direct yearly saving of $400,000, besides an unknown saving through greater efficiency.

A Garbage Pier Suit has been brought against New York City by the Hudson Navigation Co., owner of Pier 32, North River, at the foot of Canal St. The company asks for $50,000 damage and an injunction against the use of Pier 33 as a loading place for garbage boats. The complainant alleges that the conditions at the garbage pier are unsanitary and also, if reports be true, that some of its employees have contracted typhoid fever on that account.

An Unusual Kind of Engineering Banquet was given by the Engineering Department of the City of Houston, Tex., on Mar. 2, "in commemoration of the 81st anniversary of the independence of Texas and of the birth of Sam Houston the 124th." The program consisted of the reading of Governor James G. Ferguson's proclamation designating Mar. 2 as "Sam Houston Day," the reading of the Texas Declaration of Independence and a brief sketch of the state's history.

Floods in Southern Rivers reached serious proportions in the past week. At Chattanooga the Tennessee River had reached a stage of 48 ft., which is 16 ft. above official flood stage. Railway communications were interrupted and the street-railway service of the city was practically suspended. North Carolina rivers rose dangerously, and the Catawba—which did such damage in July, 1916—rose 18 ft. and carried out three wooden trestles. Alabama rivers also are at flood stage.

An Activated-Sludge Plant for treating the sewage and industrial wastes from the Chicago packing-house district has been recommended by the committee appointed to consider the question. The cost is estimated at $3,500,000, with an annual operating expense of $800,000. The Sanitary District will pay such share of the cost as will represent the treatment of domestic sewage from the district. The committee was composed of Langdon Pearse, Division Engineer of the Sanitary District of Chicago, and Dr. Richardson, Chemist for the packing-house companies.

The City-Manager Charter for Kansas City, Mo., was defeated Mar. 6 by an actual majority of 70 votes, or since the law required four-sevenths of the total vote cast in order to carry a new charter, it failed of confirmation by over 2300 votes. The foreign quarter and cheap lodging-house section of the city voted overwhelmingly against it, and while it carried in all the residence wards the majorities were not great enough to overcome this lead. Mayor Edwards opposed the proposed charter and promised if it was defeated to immediately appoint a new Board of Freeholders to draft another charter. It is probable therefore that Kansas City will have another charter election this fall.

Lien Rights for Structural Engineers are provided in a bill that has been introduced in the Illinois legislature at the instance of the Structural Engineers' Association of Illinois. There have been many cases where engineers employed in design or construction (particularly on buildings) have been unable to obtain payment for their services. In such cases the only recourse is to bring suit, and many engineers shoulder their loss rather than undertake this proceeding. The bill is identical with the law now in force, except that it gives to structural engineers the same rights as are now given to architects, contractors, material firms and laborers for a lien upon the property for the amount due for services, material or labor. The bill has been read and referred to the Committee on Judiciary.

A Tornado in Indiana sweeping over the central eastern portion of the state on Mar. 11 killed more than 20 people at Newcastle, Wayne County. The number injured may exceed 200, according to press dispatches, and the property damage is estimated at $1,000,000. Most of the buildings were destroyed in a strip 500 ft. wide and 2 miles long. The only steel-frame building in the wind zone was the main building (200 x 60 ft.) of the Indiana Rolling Mills Co. It was of ordinary mill-building construction, with steel trusses, columns, purlins, and brick curtain walls, steel sash and corrugated-iron roofing nailed to wood 8-in. channels. The roofing was ripped off and blown 2 miles, the sash was completely torn out and distorted, and a large portion of the brick walls was torn down. The frame remained practically undamaged. A large brick school building was almost demolished on the leeward side by the sucking action of the wind.

Scioto River Channel Enlargement at Columbus is now expected to be put under contract not later than September. An engineering force is being organized and condemnation appraisers are starting work. This is the outcome of the City Council's adopting the smaller one of two projects reported upon by City Engineer Henry Maetzel, Jan. 15, by instruction of the Council. The two projects were based on an improved channel width of 580 ft. through the central part of the city, but the cheaper project omitted (1) excavation of the berm, (2) improvement work on the Olentangy, which joins the Scioto in the center of the city, (3) channel improvement below Greenlawn Ave., and (4) a large amount of retaining-wall construction near the center of the city. This project was estimated just below $3,500,000, expenditure of which sum for flood protection by channel improvement was authorized by popular vote at the November election. The status of the question at that time was noted in "Engineering News" of Nov. 30, 1916, p. 1055. Following the city engineer's report of Jan. 15, the cheaper project was adopted and the preparation of detail plans was taken in hand.

PERSONALS

S. Camden Miller, whose resignation as Operating Engineer of the Canton Bridge Co. was noted in this column Jan. 4, is now Manager of the Mesker Bros. Iron Co., of St. Louis.

Charles Worthington, M. Am. Soc. C. E., formerly in private practice in New York City, has been made Designing Engineer, Bureau of Yards and Docks, Navy Department, Boston, Mass.

John A. Hoeveler, formerly Assistant Chief Engineer on design and new development work for the National X-Ray Reflector Co., is now Deputy in charge of lighting with the Wisconsin Industrial Commission.

Charles F. Rockwood, formerly Structural Engineer with the Louisville Bridge and Iron Co., is now Principal Assistant Engineer of that concern. He is a graduate of Rensselaer Polytechnic Institute, in the class of 1894.

Charles F. Gray, M. Am. Inst. E. E., consulting electrical engineer, Winnipeg, Manitoba, has been elected Controller for

that city for the ensuing year. Mr. Gray was at one time in charge of the construction staff of the Canadian Westinghouse Co.

G. L. Craig, formerly with John Gill & Sons, general contractors, Cleveland, Ohio, and L. C. Curtiss, formerly with McKim, Mead & White, New York, have organized the Craig-Curtiss Co. for doing a general contracting business in Cleveland.

C. H. McLeod, for more than 29 years Secretary of the Canadian Society of Civil Engineers, has resigned that position and will be succeeded by Fraser S. Keith, Assoc. M. Can. Soc. C. E., whose professional experience is noted elsewhere in this column.

Cyrus Hankins, recently in the mechanical engineering department of the Norfolk & Western R.R., Roanoke, Va., has been appointed mechanical engineer of the James McKay Co., McKees Rocks, Penn. He is a graduate of the Virginia Polytechnic Institute, 1911.

Leander Dorsey, Assoc. M. Am. Soc. C. E., a Rensselaer Polytechnic man, has resigned the superintendency of the Whiting-Turner Construction Co., Baltimore, Md., and is now Manager of the Construction Department of the Cram Engineering Co., of that city.

F. Clark Dugan has resigned his position with the Division of Sewerage of the City of Cincinnati, Ohio, and accepted a position as Assistant Engineer with William G. Clark, consulting engineer, Toledo, Ohio. Mr. Dugan graduated from the University of Kentucky in 1910.

Beverly F. Perry has accepted a position with the Cincinnati (Ohio) Board of Health as First Assistant Sanitary Engineer, to aid W. C. Folsom, Chief Sanitary Inspector, in making the necessary surveys and collecting data for a report on garbage collection and waste disposal for the city.

Gustavus W. Thompson, Assoc. M. Am. Soc. C. E., recently consulting engineer of the Trussed Concrete Steel Co., and Walter D. Binger have combined as Thompson & Binger, Inc., Engineers and Contractors, with offices in New York and Syracuse. Raoul C. Gautier is Chief Engineer of the new company.

H. C. Corns, M. Am. Soc. C. E., formerly Chief Engineer of the Ohio River Contract Co., and C. C. Thomas, formerly Manager of the Wetzel Engineering Co., have incorporated the Corns-Thomas Engineering and Contracting Co., and have opened offices in the First National Bank Building, Huntington, W. Va.

Frank E. Barnes, formerly Chief Engineer of the R. P. Ford Co., Rochester, and a graduate of Rennselaer Polytechnic, '98, is now Building Engineer of the Valuation Department of the New York Central R.R. He left the position of Chief Engineer of the R. P. Ford Co., of Rochester, N. Y., to take his new position.

Arthur W. Robinson, M. Am. Soc. C. E., formerly Sales Manager of the Truck Department of the Locomobile Company of America, has resigned to take the Managing Directorship of Gaston, Williams & Wigmore, Ltd., International Buildings, Kingsway, London, England. He is a graduate of the Rennselaer Polytechnic Institute, in the class of '97.

John H. Leete, Dean of the School of Applied Science, Carnegie Institute of Technology, is to be librarian of the Carnegie Library of Pittsburgh, with the title of Director, in place of H. W. Craver, resigned. Mr. Leete was born in 1868. After serving as Professor of Mathematics at the Pennsylvania State College for several years, he joined the faculty of the Carnegie Institute in 1906, becoming Dean two years later.

Fraser S. Keith, Assoc. M. Can. Soc. C. E. and new Secretary of that society, was born at Smiths Falls, Ont., in 1878. He was graduated in electrical engineering from McGill University in 1903. After a year as senior demonstrator in electrical engineering at McGill, he became Editor and later Manager of "Canadian Machinery," and in 1907 Editor of "Canadian Manufacturer." During the past 18 months he has edited "Construction."

D. F. Coyle, of Winnipeg, Man., has been appointed Industrial Commissioner in charge of the new Department of Resources of the Canadian Northern Ry., with headquarters at Winnipeg. D. B. Hanna, Vice-President of the railway, in making the appointment stated that "in anticipation of the industrial organization and development which will follow the conclusion of peace, and in view of the great number of industrial opportunities on the lines of the Canadian Northern Ry. system, the company has decided to extend its operations in that regard by creating a Department of Resources." Mr. Coyle was secretary to Sir William White from 1896 to 1901, and in the latter year became assistant to R. J. Mackenzie, of Mackenzie & Mann.

OBITUARY

W. H. Elliott, civil engineer, died in Whittier, Calif., on Feb. 28.

Oswaldo Cruz, a noted sanitary engineer of Brazil, died of uremia, on Feb. 11, at Petropolis, Brazil, at the age of 44.

Arthur Brown, architect and engineer, died at his home in Oakland, Calif., on Mar. 7, at the age of 86. Until his retirement 20 years ago he was consulting engineer of the Southern Pacific Ry.

W. H. Baldwin, M. Am. Soc. C. E., for nearly 10 years Deputy City Engineer of Yonkers, N. Y., died in that city on Mar. 6. He was born in Nashua, N. H., in 1859, was graduated from Dartmouth and has worked on municipal engineering projects in Memphis, Buffalo and Norfolk. In 1888 he became Engineer of the Yonkers Water Department, and in 1908, when the city was established, he was made Deputy City Engineer.

Alfred W. Parker, steel inspector for the Boston Transit Commission and a member of the Boston Society of Civil Engineers, died at his home in Waltham, Mass., on Feb. 24, at the age of 72 years. As a young man he and his brothers were associated with the National Bridge Works, a concern that was among the first builders of iron bridges in New England and Canada. He was next associated with Captain Eads at Pittsburgh in connection with Mississippi River improvements. After 10 years with the Boston Bridge Works he began work with the Boston Transit Commission in 1895, and during the past two years was in charge of the structural steel shop.

Peter Siems, a railroad contractor of St. Paul, Minn., and founder of the Siems-Carey Co., died at Daytona, Fla., on Mar. 3, at the age of 75. He was born in Holstein, Germany, and emigrated to the United States in 1865, coming to St. Paul in 1870. After laying out the public highways between Black Hills and Minneapolis, he entered railway-contract work in 1884 with D. C. Shepherd & Co., which later became Shepherd-Siems & Co. In 1908 the company was reorganized under the name of Siems & Co. with Mr. Siems' sons as partners. He retired six years ago and F. W. Carey became identified with the concern. Last October this company concluded a contract to build 1100 miles of railway for the Chinese Government, as noted in "Engineering News," Oct. 5, 1916, p. 673. Mr. Carey is now in China as resident manager of the project.

Col. William Douglas Pickett, of Lexington, Ky., probably the oldest living member of the American Society of Civil Engineers, died at his residence in Lexington, on Jan. 6, aged 89 years. Colonel Pickett, who was descended from an old Virginia family, won his military title by service in the Confederate Army during the Civil War. He served in the Texas Rangers. Some years after the war he emigrated to Wyoming and settled in the northwestern part of the state on the headwaters of the Grey Bull River, where he lived for many years the life of a pioneer and hunter. His exploit of killing four grizzly bears in one day was celebrated by the naming of the post office at Four Bear, as described by Ernest Seton Thompson a dozen years or more ago in his "Story of Wahb." Colonel Pickett returned some years ago to his native State of Kentucky and had resided there since. He became a member of the American Society of Civil Engineers on July 6, 1863, and was made an honorary member of the society in 1914. His only surviving relative is a brother, 92 years of age.

ENGINEERING SOCIETIES

NATIONAL RAILWAY APPLIANCES ASSOCIATION.
Mar. 20. Annual meeting in Chicago at Coliseum. Secy., C. W. Kelly, Kelly-Derby Co., Chicago.

ILLINOIS GAS ASSOCIATION.
Mar. 21-22. Annual meeting in Chicago. Secy., Horace H. Clark, 1325 Edison Building, Chicago.

AMERICAN RAILWAY ENGINEERING ASSOCIATION.
Mar. 20-22. Annual meeting. Congress Hotel, Chicago. Secy., E. H. Fritch, 900 South Michigan Ave., Chicago.

ST. LOUIS RAILWAY CLUB.
Apr. 13. Secy., B. W. Frauenthal, Union Station, St. Louis.

DETROIT ENGINEERING SOCIETY.
Apr. 21. Secy., D. V. Williamson, 46 Grand River Ave., W., Detroit.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION.
Apr. 26-28. In Dallas. Secy., H. S. Cooper, 405 Slaughter Building, Dallas, Tex.

The American Iron and Steel Institute will hold its 12th general meeting May 25 and 26 in New York City, at the Waldorf-Astoria Hotel.

The Engineers' Club of Philadelphia will hold its annual meeting on Tuesday, May 15, at the Engineers' Club. The secretary is R. H. Fernald, 1317 Spruce St.

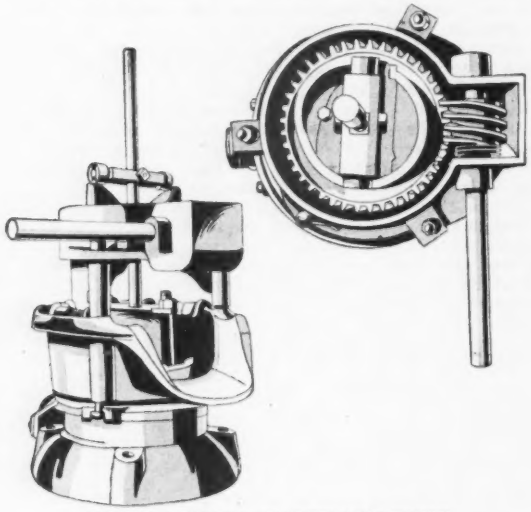
The American Chemical Society will hold its annual meeting Apr. 10 and 11, in Kansas City, at the Hotel Muehlebach. The secretary is Charles L. Parsons, Washington, D. C.

Idaho Society of Engineers—The officers elected at the annual meeting are as follows: President, Will H. Gibson, Mountain Home; vice presidents, W. O. Cotton, Idaho Falls, and G. C. Scharf, Boise; secretary, Ira F. Shaffner, Boise, Idaho.

Appliances and Materials

Worm-Drive Power Diaphragm Pump

A new type of power drive for diaphragm pumps has been placed on the market. The drive comprises a worm gear and cam lift in a frame interposed between the pump rod and the source of power, which may be a gasoline or steam engine or an electric motor. The engine turns a horizontal shaft carrying the worm gear. The worm drives a circular gear and rotates a ball-cam lift whose follower carries the pump rod. By means of this cam the reversing of the stroke can



WORM-DRIVEN DIAPHRAGM PUMP

be accomplished without shock or vibration, so that the pump is claimed to need no ballast or anchorage.

The driving mechanism is made to be readily attached to any stock diaphragm pump without alteration; it is said that the change can be made in a half-hour. The power may be applied either by belt or direct connection. The price of this attachment is $100, and that of the pump complete on a platform with a 2½-hp. gasoline engine is $175. The pump and drive alone is sold for $125. The device is made and the patents are owned by the Clinton Power Pump Co., Clinton, Mass., of which Oren B. Bates is selling agent.

* * *

Rustproofing Process for Steel

A chemical process for the rustproofing of all sorts of steel and iron articles has been developed by Clark W. Parker, of Detroit, and is being promoted by the Parker Rust-Proof Co., of that city. The rights for the use of the process are licensed to large manufacturing firms, and many automobile concerns have adopted it. Small plants can have the work done in various branches of the parent company.

The process gives a dull etched appearance to the surface, but it is claimed that neither the size nor the contour is altered. The coating is elastic; treated springs are used in the ordinary way, and parts can be drawn down without losing the rustproofing. The protection is specifically limited to atmospheric attack and not to such service as in contact with wet ashes, brine or forced blasts of warm moist air.

The rustproofing bath contains phosphate salts and is heated to the boiling point; the cleaned articles (sand blasted or pickled) are immersed and the temperature held for two hours. There is at first vigorous effervescence with the evolution of hydrogen; this action gradually slows up, owing to the deposition of a black insoluble basic iron phosphate. The articles are finally removed, air dried and dipped in oil; they may be painted or enameled.

* * *

Plane-Table Alidade with Elbow Eyepiece

W. & L. E. Gurley, Troy, N. Y., has recently placed on the market a light-weight alidade, with a 10x2¾-in. blade and an 8-in. telescope with elbow eyepiece, which is called an "explorer's" alidade. It is a companion instrument to the same company's "Explorer" transit and "Explorer" level. All three instruments may be carried in a 24-in. suitcase. The chief feature of the new alidade, aside from its light weight

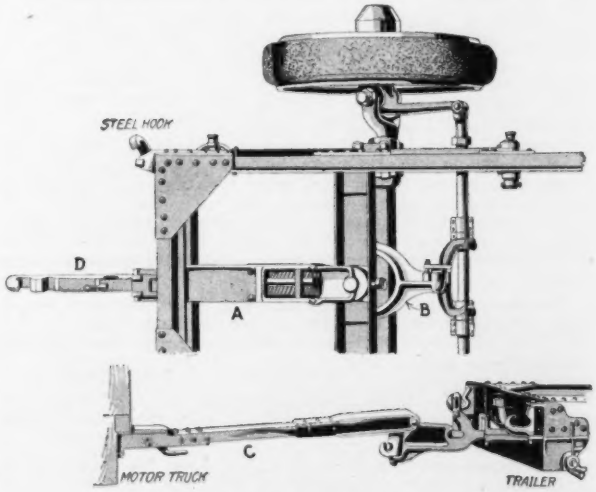
PLANE-TABLE ALIDADE WITH ELBOW EYEPIECE

and small size, is the elbow eyepiece. This is designed to relieve the fatigue and inconvenience experienced in observing with the ordinary plane-table alidade. The new eyepiece also increases the range of the instrument, making possible readings with the telescope depressed 25° or elevated to 30°. The price varies from $90 to $120, according to equipment.

* * *

Trailer-Truck Steering Gear

A new design of trailer truck for motor haulage has been made by the Warner Manufacturing Co., of Beloit, Wis., having a special coupling and steering gear to insure that the trailer will track with the tractor and neither whip out nor cut in. The tractor also can back the trailer into position. In the accompanying view, A is the drawbar, with two sets of springs to take up shock in pulling and pushing respectively. At B is a yoke hinged to the end of the drawbar (beyond the pivot) and connected by a ball-and-socket joint with the tie-



WARNER TRAILER-TRUCK DRAFT GEAR

rod yoke. In coupling truck and trailer, a coupling bar is hooked on to the truck and laid on the drawbar nose, as shown. The truck is then backed until the pin in the end of the coupling bar drops into the self-locking pocket D. Hooks for the attachment of the connecting bar are provided also at each corner of the frame, for use in operating the trailer in difficult short turns, as in placing the trailer at cars in railway yards. These trailers are made in five sizes weighing from 1 to 2 tons and having capacities of 1½ to 7 tons.